THE TWENTY-SIXTH

ANNUAL REPORT

OF THE

MARYLAND AGRICULTURAL EXPERIMENT STATION.

COLLEGE PARK,

PRINCE GEORGE COUNTY, MARYLAND

1912—1913

PUBLISHED BY THE STATION

The Maryland Agricultural Experiment Station.

CORPORATION.

The Board of Trustees of the Maryland Agricultural College.

STATION OFFICERS AND STAFF.

Harry J. Patterson	*Director and Chemistry.*
Samuel S. Buckley	*Animal Pathology.*
J. B. S. Norton	*Botany and Plant Pathology.*
Thos. B. Symons	*Horticultural Demonstrator.*
N. Schmitz	*Agronomy.*
E. H. Brinkley	*Farm Superintendent.*
Thos. H. White	*Vegetable and Floriculture.*
Chas. O. Appleman	*Plant Physiology.*
B. M. Bolton	*Biology.*
A. B. Gahan	*Entomology.*
Roy H. Waite	*Poultry.*
F. S. Holmes	*Stone Fruits.*
C. P. Smith	*Seed Inspector.*
G. E. Wolcott	*Dairy Extension.*
W. R. Ballard	*Pomology and Small Fruits.*
W. E. Hanger	*Assistant Agronomist.*
L. B. Broughton	*Assistant Chemist.*
H. J. White	*Assistant Chemist.*
R. W. Lamson	*Assistant Chemist.*
H. E. Quantz	*Assistant Agronomist.*
Roy C. Towles	*Librarian.*
H. Ford	*Treasurer.*

The Station is located on the B. & O R. R. and City and Suburban Electric Car Line, eight miles north of Washington. D. C.
Bell Telephone—Berwyn Exchange.

Visitors will be welcomed at all times, and will be given every opportunity to inspect the work of the Station in all its departments.

The Bulletins and Reports of the Station will be mailed regularly, free of charge to all residents of the State who request it.

ADDRESS:
AGRICULTURAL EXPERIMENT STATION,
College Park, Md.

LETTER OF TRANSMITTAL.

To His Excellency, P. L. Goldsborough,

Governor, and President of the Board of Trustees

Annapolis, Maryland.

SIR:—In accordance with the provisions of Section No. 3 of the Act of Congress, approved March 2, 1887, "To Establish Agricultural Experiment Stations," etc., I have the honor to transmit the Twenty-sixth Annual Report of the Maryland Experiment Station for the fiscal year ending June 30, 1913.

Very respectfully yours,

H. J. PATTERSON,

July, 1913. Director of the Experiment Station.

CONTENTS.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION

Vol. 26. 1912-1913.

TWENTY-SIXTH ANNUAL REPORT OF THE MARYLAND AGRICULTURAL EXPERIMENT STATION.

For the Year Ending June 30, 1913.

By H. J. PATTERSON, Director.

To the Board of Trustees of the

Maryland Agricultural Experiment Station.

Gentlemen:—I have the honor to submit the following report as to the work of this Institution for the past fiscal year together with recommendations for the coming year.

General Statement.

The investigations outlined in the last report have been pursued with very few changes or interruptions. The general plant and equipment has been increased and improved so that on the whole it is in better and more satisfactory shape than at any previous time. The men employed at the Station have been pursuing their investigations with energy and enthusiasm and have turned out some good work.

Financial Condition and Appropriations.

The Station is in a satisfactory financial condition. All work has been done within the Station's income.

I recommend that the several appropriations which come to the Experiment Station be expended for the coming year in accordance with the following schedule, and that the details of the expenditures be, as in the past, placed in the hands of the Director and the Agricultural and Station Committee of the Board. I also recommend that the Treasurer of the Station be authorized to draw drafts for one fourth of the amount of the State appropriations to the Station at the end of each quarter of the calendar year.

The details of the expenditures for the past fiscal year are given in the following summaries furnished by the Treasurer.

MARYLAND AGRICULTURAL EXPERIMENT STATION.

Hatch Fund.

Receipts, 1912-1913.

Appropriations—United States	$15,000.00

Disbursements, 1912-1913.

Salaries	$13,245.68
Labor	1,083.74
Publications	78.20
Postage and Stationery	80.07
Freight and Express	25.44
Chemicals and Laboratory Supplies	259.52
Library	61.75
Scientific Apparatus and Specimens	165.60
	$15,000.00

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

MARYLAND AGRICULTURAL EXPERIMENT STATION.

Adams Fund.

Receipts, 1912-1913.

Appropriations—United States	$15,000.00

Disbursements, 1912-1913.

Salaries	$11,520.32
Labor	694.32
Heat, Light, Water and Power	160.22
Chemicals and Laboratory Supplies	212.08
Seeds, Plants and Sundry Supplies	276.03
Fertilizers	7.00
Feeding Stuffs	1,061.20
Library	320.53
Furniture and Fixtures	176.25
Scientific Apparatus and Specimens	408.73
Traveling Expenses	21.66
Buildings and Land	141.66
	$15,000.00

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

MARYLAND AGRICULTURAL EXPERIMENT STATION.

Station Farm.

Receipts, 1912-1913.

Balance July 1st, 1192	$ 168.92
Sundry Receipts	10,255.20
	$10,424.12

Disbursements, 1912-1913.

Labor	$ 7,412.32
Postage and Stationery	92.90
Freight and Express	668.29
Seeds, Plants and Sundry Supplies	449.80
Fertilizers	3.10
Feeding Stuffs	375.02
Library	8.29
Tools, Machinery and Appliances	61.38
Furniture and Fixtures	97.85
Scientific Apparatus and Specimens	9.55
Live Stock	377.00
Traveling Expenses	223.18
Buildings and Land	550.79
Balance June 30th, 1913	78.14
	$10,424.12

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

MARYLAND AGRICULTURAL EXPERIMENT STATION.

State Account.

Receipts, 1912-1913.

Balance July 1st, 1912	$ 55.96
State Appropriation	12,500.00
Interest on Deposits	4.32
	$12,560.28

Disbursements, 1912-1913.

Salaries	$ 1,188.36
Labor	2,685.48
Traveling Expenses	448.15
Drainage Irrigation	71.05
Fertilizers	260.64
Chemical Supplies	145.59
Freight	174.25
Live Stock	160.00
Feed Stuff	1,286.27
Publications	1,751.42
Building and Repairs	758.69
Heat, Light and Water	79.74
Seeds, Plants and Sundry Supplies	569.88
Library	196.22
Furniture and Fixtures	85.87
Tools, Implements and Machinery	83.99
Postage and Stationery	185.10
Scientific Apparatus	1.50
Express	12.51
Exhibits	196.29
Balance July 1st, 1913	2,219.28
	$12,560.28

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

MARYLAND AGRICULTURAL EXPERIMENT STATION.

Horticultural Account.

Receipts, 1912-1913.

Balance July 1st, 1912	$ 1,883.28
State Appropriation	3,000.00
Interest on Deposits	20.36
	$ 4,903.64

Disbursements, 1912-1913.

Salaries	$ 734.79
Tools Implements and Machinery	178.87
Postage and Stationery	91.44
Seeds Plants and Sundry Supplies	849.12
Fertilizers	30.05
Traveling Expenses	288.30
Library	97.08
Labor	655.42
Building and Repairs	231.95
Publications	585.92
Contingent Expenses	20.00
Heat, Light and Water	278.04
Freight and Express	362.44
Scientific Apparatus	7.90
Furniture and Fixtures	99.72
Rent	14.79
Balance June 30th, 1913	377.81
	$ 4,903.64

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

MARYLAND AGRICULTURAL EXPERIMENT STATION.

Demonstration Fund.

Receipts, 1912-1913.

State Appropriation	$ 2,250.00

Disbursements, 1912-1913.

Salaries	$ 536.15
Poultry Demonstrations	68.00
Postage and Stationery (Hort.)	14.70
Traveling Expenses	420.44
Labor	132.20
Tools, Implements and Machinery	124.36
Seeds, Plants and Sundry Supplies	88.87
Fertilizers	96.57
Publications	33.75
Balance July 1st, 1913	735.02
	$ 2,250.00

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

MARYLAND STATE BOARD OF AGRICULTURE.

Biological Laboratory.

Receipts, 1912-1913.

Balance July 1st, 1912	$ ....
State Appropriation	7,500.00
Sundry Receipts	1,817.35
	$ 9,317.35

Disbursements, 1912-1913.

Salaries	$ 1,942.94
Traveling Expenses	564.96
Postage and Stationery	119.80
Hog Cholera Serum	843.83
Building and Repairs	2,078.96
Sundry Supplies	286.05
Furniture and Fixtures	989,33
Scientific Apparatus	483.01
Labor	664.42
Library	20.86
Tools, Implements and Machinery	46.66
Publications	183.59
Heat, Light and Water	28.89
Chemical Supplies	82.44
Live Stock	114.10
Telephone and Telegraph	4.03
Balance July 1st, 1913	862.48
	$ 9,317.35

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

STATE BOARD OF AGRICULTURE.

Seed Inspection.

Receipts, 1912-1913.

Balance July 1st, 1912	$ ....
State Appropriation	2,000.00

Disbursements, 1912-1913.

Salaries	$ 787.50
Labor	1.81
Scientific Apparatus	265.18
Balance June 30th, 1913	945.51
	$ 2,000.00

The above is a true copy from the books of this office.

Herschel Ford, *Treasurer.*

PUBLICATIONS.

The following list shows the subjects, authors and number of pages of each bulletin issued during the past year. These publications give more or less of a history of the Station's activities and the main results which have been obtained during each fiscal year.

Date.	No.	Subject.	Author.	No. pages.
July, ...1912.		25th Annual Report.	H. J. Patterson.	
July, ...1912.	168	By-Product Feeds.	H. J. Patterson & H. J. White.	1–29
Aug.,...1912.	169	Cow Testing Associations.	G. H. Hibberd & G. E. Wolcott.	29–73
Oct., ...1912.	170	The Maryland Seed Law.	C. P. Smith.	73–81
Dec., ...1912.	171	Poultry Notes.	R. H. Waite.	81–105
Jan., ...1913.	172	Irish Potato Investigations 1909–1913.	T. H. White.	105–121
Jan., ...1913.	173	Tomato Variations induced by culture.	T. H. White.	121–135
Feb., ...1913.	174	Hog Cholera.	B. M. Bolton.	135–171
Mar.. ...1913.	175	Miscellaneous Insect Pests.	T. B. Symons & E. N. Cory.	171–181
Apr., ...1913.	176	The Peach-Tree Borer.	E. N. Cory.	181–
June, ...1913.	177	The Open vs. Closed Dairy Stable.	S. S. Buckley & R. W. Lamson.	

BUILDINGS AND REPAIRS.

There has been a number of changes made in the Station building during the past year.

1st. All buildings have been given two coats of paint on the outside.

2d. The old horse barn has been remodeled and converted into a biological laboratory for the manufacture of hog cholera serum and all other biological work.

3d. The annex to the barn has been remodeled and provides laboratory, office, waiting room and bulletin storage.

4th. The old wagon shed has been remodeled and converted into a demonstration and lecture room. This has already proven to be one of the most useful rooms on the place and it afforded very good facilities for the college short course work the past winter.

5th. The tool shed has been remodeled for several phases of the hog work.

6th. The two story cow barn has been remodeled for use as a horse barn.

7th. A new calf shed 15x30 open to the South and East has been constructed of cement sides and floor and slate roof.

8th. A new cement silo 12x34 has been constructed at a cost of $200. The silage from the silo was very good.

9th. A new tool shed 24x190 was constructed. It has a cement wall 9 feet high at back and ends and is open to the East. It is divided into 16 ft. spaces which give room for two wagons to each section. This gives each wagon a special stall. The tool shed has a second floor used for the storage of small tools and supplies.

10th. Several small Hog cots have been constructed for the hog cholera work and some of the poultry houses have been remodeled.

1th. The poultry building which contained the offices, laboratories and incubator rooms in the basement were destroyed by fire. This has caused considerable loss of records and interruption to work. The insurance on this building and contents amounted to $1900. This has been deposited as a building fund to replace this equipment. The poultryman is now preparing plans for another building. I recommend that it be constructed at once and built of brick and made so that incubator room will be entirely fire proof.

12th. The revaluation of the building and reinsuring them on this new basis, for a period of five years, has caused a large insurance bill (about $2000) for one year which has made a big drain on the funds for this purpose at one time.

Investigations.

The investigations in progress are mostly continuation of those enumerated in the last report. Funds will not permit of much expansion or the taking up of new lines.

Mention will only be made of new lines of work and matter to which your attention is specifically invited.

Fertility Investigations.

There is a demand for much more definite knowledge than is possessed at present on the relative value of green manure crops and how to use them. We made a slight beginning on this subject at the Marlboro fair grounds but this was interrupted by some changes made in the grounds.

We had hoped that the MacNamee farm, which was leased last year, would give enough land for this work but after using all that was desired for the Horticultural work there was not sufficient to permit making a thorough study of this important question.

We can get enough land which is very well adapted to the work at a reasonable rental from the Scaggs Estate at Branchville, and I recommend that it be secured.

Synopsis of Horticultural Work in Prgoress.

The following is a brief statement of the work being done along Horticultural lines:

Apples:

Breeding work; New Seedlings; Disease resistence; Late blooming; Behavior of fruit buds; Woolly aphis control; Dipping nursery trees; Control of apple rust.

Peaches:

Orchard heating; Bud work; Factors influencing hardiness.

Strawberries:

Cultural and variety tests; Study of preserving fruit.

Grapes:

Breeding work; Crossing vinifera and commercial types; Cultural methods; Spraying.

Raspberries:

Variety work.

Tomatoes:

Disease resistance; Spraying tests; Fertilizer tests; Seed selection.

Potatoes:

Spraying tests; Variety and uniformity; Resistance to disease; Fertilizer tests.

Asparagus:

Varieties and fertilizers.

Cabbage:

Varieties and selection of seed for hardiness and disease resistance; Study of the cause of seeding in spring.

Sweet Corn:

Varieties of sugar corn; Corn ear worm.

Peas:

Varieties of early peas.

Canteloupes:

Seed selection; Rust resistance; Shipping; Desert qualities; Spraying.

Lettuce:

Study of strains, varieties and age of seed.

Carnations:

Stem rot; Fertilizer tests.

Geraniums:

Breeding work for producing hardy and adaptable kinds.

Roses:

Value of one, two and three year old plants; Effect on crop in different location of house.

Mignonette:

Improving for greenhouse work.

Sweet Peas:

Seed selection.

Miscellaneous:

Effect of chemicals on plants; Susceptibility or resistance to disease in connection with varieties and diseases; preserving of fruits.

Synopsis of Extension Work.

Apple:

Spraying and pruning demonstrations; Cultural methods; Fruit packing demonstrations.

Peaches:

Spraying and pruning demonstrations; Cultural methods; Fruit packing.

Strawberries:

Cultural methods.

Grapes:

Cultural methods and spraying.

Tomatoes:

Spraying demonstrations; Fertilizer and seed selection demonstrations.

Potatoes:

Spraying demonstrations.

Canteloupes:

Spraying demonstrations; Seed selection.

Floriculture and Landscape Gardening.

Beautifying rural school houses and farm homes.

Miscellaneous:

Attending farmer's meetings; Judging at agricultural fairs; Assistance in the Horticultural Society exhibit; Institute work; Short course work; Press work; Local correspondence; Local inspection and advice.

Poultry Investigations.

The poultry department made exhibits at several of the local poultry shows and at the Baltimore Show. Illustrated lectures were given at the same places in addition to the exhibit. This feature was well received and met with a much greater demand than we were able to comply with. This department has also continued to co-operate with the College in holding the one week's short course. There is a great demand for an opportunity to have practical work in poultry raising and I believe that this department of the Station should be enlarged and organized so as to give this service.

Dairy Investigations.

The results of the use of the open vs. the closed dairy barn for a period of three winters has been compiled and is now ready for press. The results show that the open barn is superior to the closed from almost every standpoint.

The dairy extension work is progressing nicely and gaining in interest. More stress is being laid on silo construction, remodeling of barns and getting people interested in pure bred bulls of the breeds adapted to local conditions. More demonstration and extension work is being done through the high schools.

Demonstration Work.

I have just completed arrangement for extending the demonstration conducted in Maryland by the U. S. Department of Agriculture and getting a closer co-operation with this Institution. The plans are briefly as follows:

1st. That all lines taken up and men engaged will be submitted to us for approval.

2d. That the leader for Maryland will have his headquarters here so that the people of the State will known that we are co-operating in the work.

3d. That nearly three times as much money will be allotted to Maryland. This will probably allow taking up work in some of the Southern Eastern Shore counties and in the extreme Western counties.

4th. The U. S. Department work in Maryland is to remain in charge of Mr. Knapp's office and not to be transferred to Mr. Spillman's office as contemplated a few months ago.

5th. That we will not be required to put up any money to get this work done in Maryland.

"Farmers Day."

As per the plan outlined one year ago, we set May 30th as Farmers Day at the Station and College. Nearly 300 people visited and inspected the work on that day and all seemed much interested in what they saw and heard.

I recommend a continuation of this plan of holding a Farmers Day at least once a year.

Seed Inspection.

I would recommend that the seed inspection be continued in accordance with the plan pursued the past year and that the money be appropriated approximately as follows:

One half time of Associate Botanist	$1000
Extra help at testing season	300
Publication of results	200
Apparatus and supplies	250
Traveling expenses	200
Contingent expenses	150
Total	$2000

A special Laboratory has been fitted up for this work in the remodeled Biological building at the Station.

Biological Laboratory.

The work in fitting up the laboratories for the hog cholera work was delayed on account of turning the building over to the College for the short courses in Agriculture which was necessary as the College fire left no place for the work. The fitting up was further delayed by the loss of some of the apparatus in the poultry laboratory fire.

The work is now taking final shape and we will be producing serum very soon.

We have however had a good supply of serum since last July so that all who desired it could get it from us. We have procured our supply from the Kansas Station and when this serum was used in time it has proven effective.

We are now about perfecting our plans so as to make the serum more accessible to the different parts of the State and also trying to work out a plan which will aid the public in checking the spread of this disease.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 168. JULY, 1912.

BY-PRODUCT FEEDS.

By H. J. Patterson and H. J. White.

The price and scarcity of whole grain and standard cattle foods has necessitated the seeking of other sources and the availing of every kind of material that animals could utilize. This condition has brought upon the market many by-products which previously were considered waste products.

Some of these by-products are found on the market in their natural condition, but many of them are finely ground and are used in the mixed feeds. In many mixed feeds it is impossible to determine the kind or nature of the material which has been used to make them.

Some people have taken the position that many of the by-products on the market were nearly worthless as a cattle food and that the placing of them in mixed foods should be regarded with suspicion, or even as a fraud. While there is a very limited amount of data available which gives definite knowledge as to the real value of these by-product feeds, yet on the other hand there is no doubt but that many of them have a food value which should be utilized. Many plants and seeds which are commonly considered as worthless weeds show by analysis a high food value, and it is well known that some animals eat them in preference to cultivated plants and thrive on them.

The making of mixed feeds or rations is a legitimate business, which is really backed by more substantial arguments than the making of mixed fertilizers. The feeding of a given kind of animals for a specific purpose is a more constant factor than the feeding of crops which are to be grown on a great variety of soils and under many conditions. The object sought in making a mixed feed should be not only for the purpose of procuring a proper "balance" or relation of the food components, but the aim should also be to improve the palatability of the ration. The palatability of a food is probably as essential for animals as for man.

The real value of a food or ration depends upon what the animals get out of it. What the animals get out of a food or ration depends chiefly upon its palatability, composition, digestibility and assimilability. It is possible for some plant constituents to stimulate and others to retard both digestion and assimilation. These facts make a greater knowledge of the effects of plant alkaloids very desirable and especially important in considering many by-product feeds. These are points

which we desire to make further investigations upon. The tests reported upon in this bulletin show something as to the composition and digestibility of a few by-products.

Experiments Conducted.

The following experiments were conducted in order to contribute some definite information on some by-product feeds which are now found in our market. These tests supplement, to some extent, the study of molasses feeds reported upon in Bulletin No. 117* of this Station.

The following is a list of the studies made and reported upon in this bulletin:

First—Determination of the digestibility of flax plant by-product.
Second—Determination of the effect of molasses on the digestibility of flax plant by-product
Third—Determination of the digestibility of ground grain screenings.
Fourth—Determination of the digestibility of buckwheat middlings.
Fifth—Determination of the digestibility of rye distillers grains.
Sixth—Botanical and mechanical analysis of grain screenings.
Seventh—Composition of some common weed seeds.
Eighth—Mechanical analysis of flax plant by-products.
Ninth—Vitality tests of seeds in grain screenings.
Tenth—Determination of the digestibility of oat hulls.
Eleventh—Maintenance tests with oat hulls.
Twelfth—Determination of quantity of live grains in oat hulls.

Feeds Used in Experiments.

The by-products used in these tests were ones which are prominently on our market at the present time and being sold either in their natural condition or in mixed feeds.

GRAIN SCREENINGS.

There are vast quantities of screenings derived from the cleaning of grains for use in making human food products. These screenings will vary greatly, according to their source. They vary according to the kind of grain, the farm and the season. Probably no two lots would ever be just the same, but yet the pooling of large lots of grains in the mills has a tendency to make the screenings more uniform than they would be otherwise.

The screenings used in this experiment came from Western Mills, and represented material which enters largely into some kinds of mixed feeds which are extensively sold in Eastern markets.

---

*Supply of this bulletin has been exhausted.

TABLE I.

Botanical and Mechanical Analysis of Grain Screenings (Sample No. 3190).

Name of Weed Seeds.	Per Cent.
Lamb's quarter	13.73
(Wheat)	13.68
Green foxtail	10.46
Black bind-weed	6.82
Wild oats	8.84
Tumbling mustard	4.42
Yellow foxtail	3.80
(Flax-seed)	2.97
Charlock	1.79
Rag-weed	1.66
Hare's ear	.69
Black mustard	.61
Smart-weed	.43
Timothy	.24
Penny cress	.16
False-flax	.12
Night-flowering catch-fly	.10
Russian thistle	.10
Roughage	8.51
Broken and too fine to identify	20.80

In addition to the seeds that have been mentioned, it contained only two or three of the following weed-seeds: chick-weed, milk-weed, Kansas sun-flower, stick-weed and clover.

The roughage consisted of all the fibrous material, such as: wheat stems, awns of wild oats, flax hulls and stems, wheat beards, and weed stems and leaves, principally lamb's quarter. That portion of the sample that was ground so fine, that it was impossible to pick out and separate the different seeds, consisted mostly of lamb's quarter, wheat grains and green foxtail.

The chemical composition of the screenings is found in table 3.

Germination Test of Unground Grain Screenings after Digestion.

A cow and horse were each fed two pounds of the unground grain screenings with middlings, bran and wheat straw each morning and night for seven days. On the evening of the seventh day they were bedded with saw dust and the dung of one night collected. The saw-dust and dung was thoroughly mixed and put in boxes and set on a bench in the green-house. The dung was collected on May 24th.

On June 21st the following weeds had germinated and grown:

Cow's Dung.

149 Lamb's quarter.
12 Pig-weeds.
14 Bind-weed.
4 Foxtail.
2 Timothy.

Horse Dung.

1213 Lamb's quarter.
28 Foxtail.
11 Pig-weeds.
12 Bind-weed.
6 Timothy.
3 Clover.
2 Morning Glory.
5 Mustard.

These results show that more weed seeds are destroyed by passing through the digestive system of a cow than of a horse. The weed seeds found in this sample of screenings are those which are common in most parts of Maryland, and already exist on most farms. Lamb's quarter, which occurred in the greatest quantity, and which is most resistant, is not an objectionable weed. It is easily killed by cultivation.

A few years ago a Maryland farmer was very enthusiastic over the value of Lamb's quarter as a cow feed. This farmer had a very rank growth of it, which his cows got access to, and they showed such a marked increase in their flow of milk that he continued feeding it and asked the Experiment Station for its analysis.

The following is the analysis of Lamb's quarter cut just as the plant was coming into bloom:

	Fresh Material.	Air Dry or Hay.
Water	66.66 per cent.	9.73 per cent.
Ash	5.48 per cent.	16.45 per cent.
Protein	8.00 per cent.	24.00 per cent.
Crude fibre	4.11 per cent.	12.32 per cent.
Nitrogen free extract	11.07 per cent.	33.21 per cent.
Crude fat	1.43 per cent.	4.29 per cent.

WEED SEEDS.

As screenings contain so large a proportion of weed seeds, it was thought of interest to collect some samples of the most common weeds in this section and make analysis of them. The results are given in Table 2. It will be noted that from a chemical point of view some of these weed seeds would rank relatively high as a food.

TABLE II.

Chemical Composition of Some Common Weed Seeds.

(Per Cent.)

Analysis Number.	Name of Weed.	Water.	Ash.	Protein.	Crude Fiber.	N-Free Extract Carbohydrates.	Ether Extract. (Fat.)
3194	Smart Weed	9.17	1.73	9.02	15.71	61.30	2.89
3195	Rag Weed	8.87	10.22	16.10	22.82	31.86	10.10
3196	Pig Weed	6.33	4.20	15.02	15.15	52.45	6.85
3197	Lamb's Quarter	9.77	3.03	14.10	19.10	46.24	7.76

These weed seeds were gathered about the middle of October and spread out on a bench in the sun so as to dry thoroughly. After drying four days, most of the chaff was rubbed off and blown out. The seeds were then ground and analyzed.

The smart-weed-seed meal has a taste similar to that of hominy-chop with a very slight bitterness.

Rag-weed-seed meal smells like pepper and has a burning taste.

Lamb's quarter and pig-weed seed meals both taste something like gluten meal.

FLAX-PLANT BY-PRODUCT.

(*Sample No.* 3191.)

This material was treated as a waste product until recently, but the high price of feeds has caused it to be utilized in mixed feeds. It acts as an absorbent or dryer for molasses.

This feed consists chiefly of flax stems, pods and broken pieces of flax seeds.

Flax stems, 75 per cent.; flax pods, 15 per cent.; flax seed, 10 per cent.

This feed is very dusty and disagreeable to handle.

FLAX-PLANT BY-PRODUCT AND MOLASSES.

(*Sample No.* 3192.)

This feed is the same as No. 3191, mixed with just enough molasses so that it does not cake and is easy to handle. The chemical composition of these feeds is given in Table III, page 6.

RYE DISTILLER'S GRAINS.

There is considerable rye used by the distillers in Maryland. At one time almost all of the refuse grains was used in the wet state near the distillery, but in recent years they are dried and shipped to distant points. According to chemical composition, and the price at which these rye grains have sold, they have been one of the cheapest feeds on our market. In order to answer more definitely some of the questions asked concerning the dried distiller's grains, a digestibility test was made of them. (See pp. 16-17.)

The chemical composition is found in Table III, page 6, from which it will be noted that they have approximately the same composition as wheat bran.

BUCKWHEAT MIDDLINGS.

The mills in the western part of Maryland produce considerable buckwheat middlings, and it is the most available and cheapest protein feed on the local market. The sample used was gotten from a mill at Friendsville, Garrett county, Maryland.

For composition, see Table III, page 6; for digestibility, see pp. 18-19.

Composition of Feeds Tested.

The following table shows the composition of the feeds described in the previous pages and used in the digestion experiments.

TABLE III.

Showing the Composition of Feeds Used in the Following Experiments.

Analysis Number.	Name.	Water.	Dry Substance.	Ash.	Nitrogen.	Protein.	Crude Fiber.	N. Free Extract.	Ether Extract. (Fat.)
3186	Distiller's Grains	6.30	93.70	1.62	2.57	16.06	14.40	49.13	12.49
3190	Ground Grain Screenings	9.00	91.00	7.96	2.32	14.52	13.50	47.37	7.65
3191	Flax-Plant By-Product	9.81	90.19	7.22	1.33	8.29	35.63	35.61	3.93
3192	Flax-Plant By-Product and Molasses	17.45	82.55	7.83	1.78	11.15	21.23	39.61	2.73
3199	Buckwheat Middlings	14.70	85.30	4.55	4.60	28.73	6.58	37.94	7.50
3200	Flax-Pt. By-Product Refused By Steer 1 (Period I.)	9.83	90.17	7.20	1.30	8.26	35.61	35.20	3.90
3201	Flax-Pt. By-Product Refused by Steer 2 (Period I.)	9.85	90.15	7.18	1.28	8.25	35.58	35.27	3.87

Duration of Experiments.

Each test was divided into two periods—first, a preliminary period, which was for the purpose of getting the animal accustomed to each feed, and also to give time for the feeds used previously to be entirely voided. The following table shows the length of the periods and the feed used in each:

TABLE IV.

Showing Time and Duration of Experiments.

Period.	Steer No.	Preliminary Began.	Digestion Began.	Digestion Ended.	Ration.
I.	Steer 1 and 2	January 22 P. M.	Jan. 29 A. M.	Feb. 3 A. M.	Flax-Pt. By-Product.
II.	Steer 1 and 2	February 3 P. M.	Feb. 12 A. M.	Feb. 17 A. M.	Flax-Pt. By-Product and Molasses.
III.	Steer 1 and 2	February 17 P. M.	Mar. 4 A. M.	Mar. 9 A. M.	Flax-Pt. By-Product and Grain Screen's.
IV.	Steer 1 and 2	March 9 P. M.	Mar. 18 A. M.	Mar. 23 A. M.	Flax-Pt. By-Product and Buck't Mid'gs.
V.	Steer 1 and 2	March 23 P. M.	Apr. 1 A. M.	Apr. 6 P. M.	Flax-Pt. By-Product and Distill'rs Gr'ns.

Steers Used.

Two Grade Short-horn Steers were used for making the digestibility tests. They were quiet and easily handled. They were in fair flesh and were fairly good feeders.

The weights during each period are given in Table V. The weights fluctuated some, but rather less than usual in such work.

TABLE V.

Showing Weights of Steers During Experiments.

Period.	Steer No.	Weight Beginning of Preliminary.	Weight at Beginning of Digestion.	Weight at End of Digestion.	Ration.
I.	Steer 1	850	905	866	Flax-Plant By-Product.
	Steer 2	940	903	877	
II.	Steer 1	866	868	876	Flax-Plant By-Product and Molasses.
	Steer 2	877	855	901	
III.	Steer 1	876	873	860	Flax-Plant By-Product and Ground Grain Screenings.
	Steer 2	901	849	866	
IV.	Steer 1	860	854	844	Flax-Plant By-Product and Buckwheat Middlings.
	Steer 2	866	850	846	
V.	Steer 1	844	918	905	Flax-Plant By-Product and Distiller's Grain.
	Steer 2	846	925	892	

Composition of Dung and Urine.

The dung and urine was collected by means of the apparatus designed by Dr. H. P. Armsby, of the Pennsylvania Experiment Station, and described in Bulletin 43 of this Station. The composition of the dung is given in Table VI and of the urine in Table VII.

TABLE VI.
Composition of Dung Collected During Digestion Experiments.
(Per Cent.)

Analysis Number.	Steer Number.	Water.	Dry Substance.	Ash.	Nitrogen.	Protein.	Crude Fiber.	Ether Extract (Fat.)	N-Free Extract Carbohydrates.
PERIOD I. FLAX PLANT BY-PRODUCT.									
3202	1	69.83	30.17	2.45	.34	2.10	13.75	.83	11.04
3203	2	69.71	30.29	2.33	.31	1.93	13.12	.94	11.97
PERIOD II. FLAX PLANT BY-PRODUCT AND MOLASSES.									
3204	1	73.03	26.97	2.22	.44	2.73	10.91	.74	10.85
3205	2	72.55	27.45	2.43	.54	3.35	10.20	.91	10.76
PERIOD III. FLAX PLANT BY-PRODUCT AND GRAIN SCREENINGS.									
3206	1	73.96	26.04	2.87	.42	1.49	10.30	1.09	10.29
3207	2	73.69	26.31	2.92	.40	1.46	8.45	1.33	12.15
PERIOD IV. FLAX PLANT BY-PRODUCT AND BUCKWHEAT MIDDLINGS.									
3208	1	75.00	25.00	2.71	.46	2.85	9.51	1.00	8.93
3209	2	74.90	25.10	2.86	.45	2.79	9.20	1.44	8.81
PERIOD V. FLAX PLANT BY-PRODUCT AND DISTILLER'S GRAINS.									
3210	1	76.52	23.48	1.82	.46	2.83	7.65	1.11	10.07
3211	2	77.06	22.94	1.60	.42	2.62	6.93	1.01	10.80

TABLE VII.
Showing the Quantity and the Nitrogen Contents of the Urine Excreted During the Five Days of Digestion Period.

Period.	STEER 1. Quantity in Grams.	STEER 1. Nitrogen Per Cent.	STEER 2. Quantity in Grams.	STEER 2. Nitrogen Per Cent.
I.	5896*	2.34	9742*	2.11
II.	39010*	.83	35834*	.78
III.	15149*	1.91	17398*	1.90
IV.	13964*	2.42	11476*	2.20
V.	10598*	2.53	11420*	2.13

*Some urine lost.

It will be noted that in Period II, in which the flax plant by-product and molasses was fed, that the quantity of urine excreted is much higher than in any other period, and that the per cent. of nitrogen lower. The steers drank almost twice as much water when eating molasses as during any other period. This fact may be helpful in influencing an increased milk production.

PERIOD I. TEST OF THE DIGESTIBILITY OF FLAX PLANT BY-PRODUCT.

TABLE VIII.

Showing the Consumption of Food and Water During Digestion Period I.

Feed Eaten and Water Drunk. Weight in Grams (453.6 grams equal 1 Pound).

Portion of Period.	Flax By-Product Eaten. No. Days.	Total.	Average Per Day.	Water Drank Total.	Average Per Day.
STEER 1.					
Preliminary	7	46539.0	6648.0	96662.0	13952.0
Digestion	5	14515.0	2903.0	28304.0	5661.0
STEER 2.					
Preliminary	7	43183.0	6169.0	91264.0	13038.0
Digestion	5	22680.0	4536.0	38647.0	7729.0

TABLE IX.

Showing the Digestibility of Flax Plant By-Product, Period I.

Length of Preliminary Period 7 Days, and Digestion Period 5 Days.

Weight in Grams (453.6 Grams equal 1 Pound).

STEER 1.	Analysis Number.	Fresh Substance.	Dry Substance.	Ash.	Nitrogen.	Protein.	Crude Fiber.	Ether Extract (Fat.)	N-Free Extract Carbohydrates.
Flax By-Product Fed	3191	15513.	13991.2	1120.0	206.3	1286.0	5527.3	609.7	5524.1
Flax By-Prod't Refused	3200	908.	900.1	71.8	12.9	82.7	365.5	39.1	350.2
Total Eaten	----	14515.	13091.1	1049.2	193.4	1203.3	5170.8	570.6	5173.9
Total Excreted	3202	25174.8	7595.3	616.8	85.6	528.7	3461.5	208.9	2779.3
Total Digested	----	------	5495.8	432.4	107.8	674.6	1709.3	361.7	1394.6
Per Cent. Digested	----	------	41.98	41.21	55.74	55.74	33.05	71.25	26.95
STEER 2.									
Flax By-Product Fed	3191	33587.2	30292.3	2425.0	436.7	2784.4	11967.1	1320.0	11960.4
Flax By-Prod't Refused	3201	907.2	817.9	65.1	7.8	74.9	323.0	35.4	319.3
Total Eaten	----	22680.0	29474.4	2359.9	428.9	2709.5	11644.1	1284.6	11641.1
Total Excreted	3203	39926.8	12095.1	930.3	123.8	770.5	4236.4	375.3	4779.2
Total Digested	----	------	17379.3	1429.6	305.1	1939.0	7407.7	909.3	6861.9
Per Cent. Digested	----	------	58.96	60.50	71.13	71.13	63.60	78.56	59.0
Average of 2 Steers	----	------	50.52	50.85	63.43	63.43	48.32	74.95	42.97

TABLE X.

Showing Comparison of Composition and Digestibility of Flax Plant By-Product with Common Hays and Fodders.

(Per Cents.)

	Dry Substance.	Ash.	Protein.	Crude Fiber.	N-Free Extract. (Starch, Etc.)	Crude Fat.
Composition.						
Flax-Plant By-Product	90.19	7.22	8.29	35.63	35.61	3.93
Timothy Hay	86.8	4.4	5.9	29.0	45.0	2.5
Corn Fodder	59.5	3.4	3.8	19.7	31.5	1.1
Clover Hay	84.7	6.2	12.3	24.8	38.1	3.3
Coefficient of Digestibility.						
Flax-Plant By-Product	50.5	50.8	63.4	48.3	43.0	74.9
Timothy Hay	57.0	---	48.0	52.0	63.0	57.0
Corn Fodder	60.0	---	45.0	67.0	61.0	62.0
Clover Hay	61.0	---	62.0	49.0	69.0	62.0
Quantity of Digestible Constituents in 100 Pounds of Feed.						
Flax-Plant By-Product	45.5	3.7	5.3	17.2	15.3	2.94
Timothy Hay	49.5	---	2.8	15.3	28.4	1.4
Corn Fodder	35.7	---	1.7	13.2	19.2	.68
Clover Hay	51.7	---	7.6	12.2	26.3	2.0

From the above figures it will be seen that flax plant by-product, furnished on the average about the same amount of digestible nutrients as timothy hay. It furnishes nearly twice as much digestible protein and fat as is furnished by timothy hay. Flax plant by-product furnishes more digestible nutrients than corn fodder, but not as much as clover hay.

Period II. Test of the Effect of Molasses on the Digestibility of Flax Plant By-Product.

TABLE XI.

Showing the Consumption of Flax Plant By-Product and Molasses and Water During Digestion Period II.

Food Eaten and Water Drank. Weight in Grams (453.6 Grams equal 1 Pound).

Portion of Period.	No. of Days.	Eaten. Flax Plant By-Product		Water Drank.	
		Total.	Average per Day.	Total.	Average per Day.
STEER 1.					
Preliminary	9	73937.0	8215.	173946.	19327.
Digestion	5	46267.0	9253.	111039.	22207.
STEER 2.					
Preliminary	9	57153.	6350.	121328.	13481.
Digestion	5	41731.	8346.	106939.	21387.

TABLE XII.

Showing the Digestibility of Flax-Plant By-Product and Molasses.

Digestion Period II. Preliminary Period 9 Days and Digestion Period 5 Days.

Weight in Grams (453.6 Grams equal 1 Pound).

STEER 1.	Analysis Number.	Fresh Substance.	Dry Substance.	Ash.	Nitrogen.	Protein.	Crude Fiber.	Ether Extract (Fat.)	N-Free Extract (Carbohydrates.)
Total Eaten	3192	46267.	38194.	3622.7	823.5	5158.7	9822.4	1323.0	18326.3
Total Excreted	3204	6644.2	17919.5	1475.0	292.3	1813.8	7248.8	491.6	7208.9
Total Digested	----	-----	20274.5	2147.7	531.2	3344.9	2573.6	831.4	11117.4
Per Cent Digested	----	-----	53.08	59.83	64.50	64.50	26.20	62.84	60.66
STEER 2.									
Total Eaten	3192	41731.	34449.0	3267.5	742.8	4642.9	8859.6	1139.2	16515.6
Total Excreted	3205	54332.	14914.2	1320.2	293.4	1820.0	5541.8	494.4	5846.1
Total Digested	----	-----	19534.8	1947.3	449.4	2822.9	3317.8	644.8	10669.5
Per Cent Digested	----	-----	56.70	59.59	60.50	60.50	37.48	56.60	64.60
Average of 2 Steers	----	-----	54.89	59.71	62.50	62.50	31.84	59.72	62.63

TABLE XIII.

Showing Comparison of Digestibility of Flax Plant By-Product with and without Molasses.

	Dry Substance.	Ash.	Protein.	Crude Fiber.	N-Free Extract.	Crude Fat.
Flax-Plant By-Product	50.5	50.8	63.4	48.3	43.0	74.0
Flax-Plant By-Product and Molasses	54.9	59.7	62.5	31.8	62.3	59.7

It will be noted from the above that the molasses seemed to increase the digestibility of the total dry matter, the ash and the carbohydrates, but caused a decrease in the digestibility of the protein, fat and fiber.

Period III. Test of the Digestibility of Ground Grain Screenings.

In all of the following periods flax plant by-product was fed as a roughage. It was fed in the proportion 1 : 1, i. e., one pound of flax plant by-product was added to each pound of grain.

The feed was weighed and thoroughly mixed at feeding time.

TABLE XIV.

Showing the Consumption of Food and Water During Digestion Period III.

Food Eaten and Water Drank. Weight in Grams (453.6 Grams equals 1 Pound).

Portion of Period.	Number of Days.	Food Eaten.		Water Drank.	
		Total.	Average per day.	Total.	Average per day.
STEER 1.					
Preliminary	16	135173.	8448.	253517.0	15845.
Digestion	5	38102.	7620.	75071.0	15014.
STEER 2					
Preliminary	16	101606.	6350.	191237.0	11952.
Digestion	5	36288.	7258.	70535.0	14107.

Steer 2 was sick (was off his feed and had very loose bowels) and it was necessary to continue the preliminary feeding for another week. During the first part of the second week of the preliminary feeding he was given 8618.4 grams of bran.

TABLE XV.

Showing the Digestibility of Ground Grain Screenings, Digestion Period III. Preliminary Period 16 Days and Digestion Period 5 Days. Weight in Grams (453.6 equal 1 Pound).

STEER 1.	Analysis Number.	Fresh Substance.	Dry Substance.	Ash.	Nitrogen.	Crude Protein.	Crude Fiber.	Ether Extract. (Fat.)	N-Free Extract. (Carbohydrates.)
Flax-Plant By-Product Eaten	3191	19051.	17182.1	1375.5	253.4	1579.3	6787.8	748.7	6784.0
Grain Screenings Eaten	3190	19051.	17236.4	1516.5	442.0	2766.2	2571.9	1457.4	9024.4
Total Eaten	----	38102.	34418.5	2892.0	695.4	4345.5	9359.7	2206.1	15808.4
Total Excreted	3206	63185.	16453.4	1813.6	265.4	941.5	6514.0	688.7	6501.6
Total Digested	----	-----	17965.1	1078.4	430.0	3404.0	2845.7	1517.4	9306.8
Flax-Plant By-Product Digested	3191	-----	7213.0	566.8	141.3	808.3	2243.4	533.4	1828.3
Grain Screenings Digested	3190	-----	10752.1	511.6	288.7	2595.7	602.3	984.0	7478.5
Per Cent. Digested	----	-----	62.32	33.73	65.32	65.32	23.80	67.52	82.87
STEER 2.									
Flax-Plant By-Product Eaten	3191	18144.	16364.	1310.0	241.3	1504.1	6464.7	713.0	6461.1
Grain Screenings Eaten	3190	18144.	16511.0	1444.3	420.9	2634.5	2449.4	1388.0	8594.8
Total Eaten	----	36288.	32875.0	2754.3	662.2	4138.6	8914.1	2101.0	15055.9
Total Excreted	3207	53606.	14103.7	1565.3	214.4	782.6	4529.7	713.0	4513.0
Total Digested	----	-----	18771.3	1189.0	447.8	3356.0	4384.4	1388.0	10542.9
Flax-Plant By-Product Digested	3191	-----	9628.2	792.5	171.6	1070.0	4111.3	560.1	3812.0
Grain Screenings Digested	3190	-----	9143.1	396.5	276.2	2286.0	273.1	827.9	6730.9
Per Cent. Digested	----	-----	55.38	27.45	65.62	65.62	11.15	59.65	78.31
Average of 2 Steers	----	-----	58.85	30.59	65.47	65.47	17.48	63.59	80.59

Period IV. Test of the Digestibility of Buckwheat Middlings.

TABLE XVI.

Showing the Consumption of Food and Water During Period IV.

Food Eaten and Water Drank. Weight in Grams (453.6 Grams equals 1 Pound).

Portion of Period.	Number of Days.	Food Eaten.		Water Drank.	
		Total.	Average per day.	Total.	Average per day.
STEER 1.					
Preliminary	9	62597.	6955.	129729.	14192.
Digestion	5	34474.	6895.	86411.	17280.
STEER 2.					
Preliminary	9	58968.	6552.	119524.	13281.
Digestion	5	34474.	6895.	81194.	16239.

TABLE XVII.

Showing the Digestibility of Buckwheat Middlings, Digestion Period IV.

Preliminary Period 9 Days and Digestion Period 5 Days.

Weight in Grams (453.6 Grams equal 1 Pound).

STEER 1.	Analysis Number.	Fresh Substance.	Dry Substance.	Ash.	Nitrogen.	Crude Protein.	Crude Fiber.	Ether Extract. (Fat.)	N-Free Extract. (Carbohydrates.)
Flax-Plant By-Product Eaten	3191	17237.	15546.	1244.5	229.3	1428.9	6141.5	677.4	6138.1
Buckwheat Middlings Eaten	3199	17237.	14703.	784.3	792.9	4941.2	1134.2	1292.7	6539.7
Total Eaten	----	34474.	30249.	2028.8	1022.2	6370.1	7275.7	1970.1	12677.8
Total Excreted	3208	47791.	11947.7	1195.1	119.8	1362.0	4544.9	477.9	4267.7
Total Digested	----	-----	18301.3	833.7	902.4	5008.1	2730.6	1492.2	8410.1
Flax-Plant By-Product Digested	3191	-----	6426.2	512.7	127.7	796.5	2029.8	482.6	1654.2
Buckwheat Middlings Digested	3199	-----	11775.1	321.0	774.7	4211.6	700.8	1009.6	6755.9
Per Cent. Digested	----	-----	80.08	40.92	97.70	97.70	61.78	78.10	103.3
STEER 2.									
Flax-Plant By-Product Eaten	3191	17237.	15546.	1244.5	229.3	1428.9	6141.5	677.4	6138.1
Buckwheat Middling Eaten	3199	17237.	14703.	784.3	792.9	4941.2	1134.2	1292.7	6539.7
Total Eaten	----	34474.	30249.	2028.8	1022.2	6370.1	7275.7	1970.1	12677.8
Total Excreted	3209	45449.	11408.7	1299.8	194.5	1268.1	4181.3	643.5	4004.1
Total Digested	----	-----	18840.3	729.0	827.7	5102.0	3094.4	1326.6	8673.7
Flax-Plant By-Product Digested	3191	-----	9165.9	752.9	163.1	1016.8	3906.0	532.1	3621.5
Buckwheat Middlings Digested	3199	-----	9674.4	none	664.6	4085.2	none	794.5	5052.2
Per Cent. Digested	----	-----	65.80	none	83.82	83.82	none	69.20	77.25
Average of 2 Steers	----	-----	72.94	20.46	90.76	90.76	30.89	73.65	90.77

PERIOD V. TEST OF THE DIGESTIBILITY OF RYE DISTILLERS GRAINS.

TABLE XVIII.

Showing the Consumption of Food and Water During Period V.

Food Eaten and Water Drank. Weight in Grams (435.6 Grams equal 1 Pound).

Portion of Period.	Number of Days.	Food Eaten.		Water Drank.	
		Total.	Average per day.	Total.	Average per day.
STEER 1.					
Preliminary	9	65298.	7255.	159440.	17715.5
Digestion	5	36288.	7257.	87545.	17509.0
STEER 2.					
Preliminary	9	65298.	7255.	148554.	16506.0
Digestion	5	36288.	7257.	90266.	18053.0

TABLE XIX.

Showing the Digestibility of Distiller's Grains. Digestion Period V.

Preliminary Period 9 Days and Digestion Period 5 Days.

Weight in Grams (453.6 Grams equal 1 Pound).

	Analysis Number.	Fresh Substance.	Dry Substance.	Ash.	Nitrogen.	Protein.	Crude Fiber.	Ether Extract. (Fat.)	N-Free Extract. (Carbohydrates.)
STEER 1.									
Flax-Plant By-Product Eaten	3191	18144.	16364.	1310.0	241.3	1504.1	6464.7	713.1	6461.1
Distiller's Grains Eaten	3186	18144.	16999.9	293.9	466.3	2913.5	2612.7	2226.4	8914.1
Total Eaten	----	36288.	33363.9	1603.9	707.6	4417.6	9077.4	2979.5	15375.2
Total Excreted	3210	75524.	17733.0	1375.3	347.4	2137.3	5777.6	838.3	7605.3
Total Digested	----	-----	15630.9	228.6	360.2	2280.3	3299.8	2141.2	7769.9
Flax-Plant By-Product Digested	3191	-----	6869.6	539.8	314.5	838.4	2136.6	508.1	1743.3
Distiller's Grains Digested	3186	-----	8761.3	none	225.7	1441.9	1163.2	1633.1	6026.6
Per Cent. Digested	----	-----	51.54	none	48.4	48.4	44.52	72.05	67.60
STEER 2.									
Flax-Plant By-Product Eaten	3191	18144.	16364.	1310.0	241.3	1504.1	6464.7	713.1	6461.1
Distiller's Grains Eaten	3186	18144.	16999.9	293.9	466.3	2913.5	2612.7	2266.4	8914.1
Total Eaten	----	36288.	33363.9	1603.9	707.6	4417.6	9077.4	2979.5	15375.2
Total Excreted	3211	85585.	19633.2	1369.4	359.4	2241.3	5931.0	864.4	9243.2
Total Digested	----	-----	13730.7	234.5	348.2	2176.3	3146.4	2115.1	6132.0
Flax-Plant By-Product Digested	3191	-----	9648.4	792.5	171.6	1069.8	4121.5	560.2	3812.3
Distiller's Grains Digested	3186	-----	4082.3	none	176.6	1106.5	none	1554.9	2319.7
Per Cent. Digested	----	-----	24.02	none	37.87	37.87	none	68.66	26.02
Average for 2 Steers	----	-----	37.78	none	43.19	43.19	22.26	70.35	46.81

SUMMARY.

TABLE XX.

Showing the Average Coefficients of Digestibility Obtained in the Experiments, Together With Those of Some Other Common Feeds for Comparison.

(Average of Results Obtained with 2 Steers).

	Dry Substance.	Ash.	Crude Protein.	Crude Fiber.	N-Free Extract.	Fat.
	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.	Per Ct.
1. Flax-Plant By-Product	50.52	50.85	63.43	48.32	42.97	74.95
2. Flax-Plant By-Product and Molasses	54.89	59.71	62.50	31.84	62.63	59.72
3. Ground Grain Screenings	58.85	30.59	65.47	17.48	80.59	63.59
4. Buckwheat Middlings	72.94	20.46	90.76	30.89	90.77	73.65
5. Distiller's Grains	37.78	----	43.19	22.26	46.81	70.35
6. Oat Hulls	54.1	----	50.1	59.9	52.7	76.7
Wheat Bran (Average of all tests)	66.0	----	77.0	41.0	71.0	63.0
Brewer's Grains (Average of all tests)	62.0	----	79.0	53.0	59.0	91.0
Rye Distiller's Grains (Average of all tests)	58.0	----	59.0	----	67.0	84.0
Corn Distiller's Grains (Average of all tests)	79.0	----	73.0	95.0	81.0	95.0
Wheat Middlings (Average of all tests)	79.0	----	82.0	30.0	85.0	85.0
Corn Meal (Average of all tests)	88.0	----	60.0	----	93.0	92.0

From the above table it will be seen that ground grain screening is more digestible than distiller's grains, but not quite as digestible as wheat bran.

The test of distillers grains did not give as high results as the samples reported upon in Henry's Feeds and Feeding. This may have been due to a difference in quality or to a difference of individuality of steers used.

The buckwheat middlings showed nearly as good digestibility as wheat middlings and much better digestibility than wheat bran.

TABLE XXI.

Showing the Nitrogen Metabolism During the Different Digestion Periods.

PERIOD.	Steer No.	N. in Urine Grams.	N. in Dung Grams.	Total Excreted.	Total Eaten.	Total Stored.	Per Cent. Stored.	Per Cent. of Excreted Nitrogen in Urine.
I.								
Flax-Plant By-Product	1	136.96	85.6	222.6	193.4	none	----	62.4
	2	205.55	123.8	329.4	428.9	99.5	23.2	62.4
Average		171.25	104.7	276.0	311.1	49.7	11.6	62.4
II.								
Flax-Plant By-Product and	1	323.8	292.3	616.0	823.5	207.5	25.2	52.7
Molasses	2	279.5	293.4	572.9	742.8	169.9	22.8	48.7
Average	-----	301.6	292.9	594.5	783.2	188.7	24.0	50.7
III.								
Flax-Plant By-Product and	1	289.8	265.4	455.2	695.5	240.2	34.5	63.6
Grain Screenings	2	329.6	214.4	544.0	662.2	118.2	17.8	60.6
Average		309.7	239.9	499.6	678.8	179.2	26.1	62.1
IV.								
Flax-Plant By-Product and	1	337.9	119.8	457.7	1022.2	564.5	55.2	73.8
Buckwheat Middlings	2	252.5	194.5	447.0	1022.2	575.2	56.2	56.5
Average	-----	295.2	157.1	452.3	1022.2	569.8	55.7	65.1
V.								
Flax-Plant By-Product and	1	268.1	353.4	609.0	707.6	98.5	16.2	42.0
Distiller's Grains	2	242.2	347.4	615.5	707.6	92.1	15.0	43.6
Average	-----	255.1	359.4	602.6	707.6	105.0	17.5	40.4

TEST OF OAT HULLS.

By S. S. Buckley, L. B. Broughton and R. H. Ruffner.

One of the by-products resulting from the separation of meal from whole oats is oat hulls. These are usually regarded as having about the same feeding value for farm animals as straw or very poor quality hay. The fact, however, of being in a finely sub-divided state, and easily miscible with meal, makes them an ideal "filler" or "adulterant," as the case may be, in prepared stock foods. They become an "adulterant" principally when the mixed food is claimed to be prepared in part from crushed oats where hulls only are present.

The smaller the quantity of fine meal present in the hulls, the poorer its food value, but where any considerable quantity exists, oat hulls may serve a useful purpose—provided they can be purchased at a low price.

A car load of oat hulls was secured for the purpose of carefully testing their food value. On physical examination the sample appeared to be light in weight, of good color and extremely dusty. It was noted that several days after rain had fallen upon a spilled portion, near the barn, a number of shoots appeared, and closer examination revealed the presence of oat germs in considerable quantities.

To determine the number of germs in a definite amount of hulls, five germinating boxes were prepared and the following results obtained:

Box 1.—10 grams hulls—11 days—	4 shoots.
Box 2.—10 grams hulls—11 days—	9 shoots.
Box 3.—10 grams hulls—11 days—	6 shoots.
Box 4.—10 grams hulls—11 days—	9 shoots.
Box 5.—10 grams hulls—11 days—	6 shoots.
Total 5 Boxes, 50 grams.	34 shoots.

Average from 10 grams hulls, six and four-fifths shoots. This indicated a high grade of oat hulls.

Feeding Test.

The initial test was purely maintenance test, in which three animals were used—a young pig, a mature mule and a mature Jersey bull.

Maintenance Test—Pig.

DATE.		WEIGHT.	AMT. OF OAT-HULLS FED.
July	21	75	--
July	22	--	--
July	23	76	--
July	24	--	--
July	25	--	--
July	26	--	--
July	27	69	3.6 lbs.
July	28	--	--
July	29	--	--
July	30	--	--
July	31	66	2.0 lbs.
Aug.	1	--	2.2 "
Aug.	2	--	1.8 "
Aug.	3	--	2.7 "
Aug.	4	--	3.7 "
Aug.	5	--	2.0 "
Aug.	6	--	2.0 "
Aug.	7	65	1.5 "
Aug.	8	--	2.0 "
Aug.	9	--	2.5 "
Aug.	10	--	2.3 "
Aug.	11	--	2.1 "
Aug.	12	--	2.1 "
Aug.	13	65	2.4 "
Aug.	14	65	1.3 "
Aug.	15	--	1.3 "
Aug.	16	--	1.2 "
Aug.	17	--	1.0 "
Aug.	18	--	1.8 "
Aug.	19	67	2.9 "
Aug.	20	--	1.8 "
Aug.	21	--	1.8 "
Aug.	22	--	1.8 "
Aug.	23	--	1.8 "
Aug.	24	65	1.8 "
Aug.	25	--	1.8 "
Aug.	26	--	1.8 "
Aug.	27	--	1.8 "
Aug.	28	62	1.8 "
Aug.	29	--	1.8 "
Aug.	30	--	1.8 "
Aug.	31	54	1.8 "

Total 41 days, net loss 21 lbs., or a loss of 28 per cent.

It will be seen, however, that the excessive loss was partially due to the limited amount consumed, and not entirely to the poor food value in itself. At the end of the period, however, the pig was very weak and would probably have died in a short time on this exclusive diet.

MAINTENANCE TEST—MULE.

DATE.	WEIGHT.	OAT HULLS FED.	HAY.
July 21	1007.5		
July 22	1008.0	10.0	12.2
July 23		10.0	11.0
July 24		10.5	12.2
July 25		10.5	11.5
July 26		7.0	10.2
July 27	1000.0	10.5	10.6
July 28		10.5	11.2
July 29		7.0	11.2
July 30		10.5	7.5
July 31		10.5	13.0
Aug. 1	1000.0	7.0	12.6
Aug. 2		7.0	---
Aug. 3		10.5	12.4
Aug. 4		10.5	10.0
Aug. 5	990.0	10.5	10.5
Aug. 6		7.0	11.0
Aug. 7		10.5	12.0
Aug. 8		10.5	12.5
Aug. 9		10.5	---
Aug. 10		10.5	10.0
Aug. 11		7.0	14.7
Aug. 12		10.5	13.0
Aug. 13	940.0	10.5	11.0
Aug. 14		10.5	12.0
Aug. 15		10.5	10.5
Aug. 16		7.0	5.0
Aug. 17		10.5	7.4
Aug. 18		10.5	14.4
Aug. 19	970.0	14.0	11.5
Aug. 20		14.0	---
Aug. 21		14.0	12.9
Aug. 22		14.0	3.2
Aug. 23		10.5	7.0
Aug. 24	965.0	14.0	15.1
Aug. 25		10.5	11.7
Aug. 26		10.5	---
Aug. 27		10.5	6.4
Aug. 28	980.00	14.0	11.8
Aug. 29		10.5	10.0
Aug. 30		10.5	10.0
Aug. 31	985.0	10.5	10.0

In this test it would seem that with hay the oat hulls would have supported the animal fairly well at light work.

The general condition of the mule was good throughout the entire period.

Maintenance Test—Bull.

DATE.	WEIGHT.	OAT HULLS FED.	HAY.
July 21	705.0		---
July 22	681.0	10.0	7.5
July 23		10.0	6.2
July 24	710.0	10.0	8.7
July 25		10.0	8.7
July 26		10.0	10.8
July 27	690.0	10.0	10.2
July 28		10.0	9.8
July 29		10.0	9.6
July 30		10.0	10.4
July 31	690.0	12.0	---
Aug. 1		16.0	---
Aug. 2		5.0	---
Aug. 3	702.0	10.2	---
Aug. 4		10.0	---
Aug. 5		10.0	---
Aug. 6		10.0	---
Aug. 7		10.0	---
Aug. 8		10.0	---
Aug. 9		10.0	---
Aug. 10		10.0	---
Aug. 11	720.0	6.0	---
Aug. 12		12.0	---
Aug. 13		13.3	---
Aug. 14		19.0	---
Aug. 15		6.0	---
Aug. 16		10.0	---
Aug. 17		10.0	---
Aug. 18		15.0	---
Aug. 19		16.0	---
Aug. 20	746.00	10.0	---
Aug. 21		5.0	---
Aug. 22		5.0	---
Aug. 23		10.5	---
Aug. 24	752.00	10.0	---
Aug. 25		10.0	---
Aug. 26		15.0	---
Aug. 27		15.0	---
Aug. 28	752.00	10.0	---
Aug. 29		11.0	---
Aug. 30		10.0	---
Aug. 31	734.00	10.0	---

At the end of the 41 days' period the bull had gained 29 lbs. in weight.

During the first nine days, however, he received hay in addition to oat hulls, and when hay was discontinued he had up to this lost apparently 15 lbs. This was an error, probably due to his having been watered shortly before the initial weighing. For the remainder of the time he gradually improved on an exclusive oat hull diet, and at the end of the period was in excellent condition in every respect.

Digestion Test—Bull.

Immediately following the maintenance test with the bull, the exclusive oat hull diet was continued as preliminary to the digestion test, which follows:

The preliminary period extends from September 1st to 16th, inclusive, with animal confined in the digestion stall and the usual apparatus for collecting samples applied. Samples were obtained from the morning of the 8th to the 12th, inclusive. A daily ration of ten pounds of oat hulls was consumed during the entire period with the exception of the last day, on which only four and three-tenths pounds were consumed.

ANALYSIS OF OAT HULLS.

Analysis as Sampled.

Moisture	8.220 per cent.
Ash	6.300 per cent.
Protein	4.318 per cent.
Fat or Ether Extract	3.04 per cent.
Crude Fiber	28.750 per cent.
Other Carbohydrates	49.372 per cent.

(Nitrogen 0.691 per cent.)

URINE.

September 8, 1908—Amount collected	1300 c. c.—weighing	1333.0 g.
September 9, 1908—Amount collected	2300 c. c.—weighing	2339.0 g.
September 10. 1908—Amount collected	22530 c. c.—weighing	2571.5 g.
September 11, 1908—Amount collected	2240 c. c.—weighing	2280.0 g.
September 12, 1908—Amount collected	3100 c. c.—weighing	3190.0 g.
Amount collected in 5 days	11470 c. c.—weighing	11713.5 g.

NITROGEN IN URINE.

Sept. 8	.720 per cent.
Sept. 9	.789 per cent.
Sept. 10	.796 per cent.
Sept. 11	.868 per cent.
Sept. 12	.846 per cent.

ANALYSIS OF FAECES.

First sample taken Sept. 8, 1908, at 10.30 a. m.
Last sample taken Sept. 12, 1908, at 10.30 a. m.

Sept. 8, 1908.—Amount collected	6620 gms. 1-20 taken as sample	331.0 g.
Sept. 9, 1908.—Amount collected	5800 gms. 1-20 taken as sample	290.0 g.
Sept. 10, 1908.—Amount collected	5950 gms. 1-20 taken as sample	297.5 g.
Sept. 11, 1908.—Amount collected	6340 gms. 1-20 taken as sample	317.0 g.
Sept. 12, 1908.—Amount collected	8270 gms. 1-20 taken as sample	413.5 g.
Amount collected in 5 days	32980 gms. 1-20 taken as sample	1649.0 g.

ANALYSIS AS SAMPLE.

Moisture	74.35 per cent.
Ash	2.843 per cent.
Protein	1.311 per cent.
Fat or Ether Extract	.431 per cent.
Crude Fiber	7.002 per cent.
Other Carbohydrates	14.064 per cent.

5 Days Test	Dry Matter.	Protein.	Crude Fiber.	Nitrogen Free Extract.	Ether Extract or Fat.
Fed Daily Av. 4015.795 g. Oat Hulls Containing	3685.69 g.	173.40 g.	1154.54 g.	1982.54 g.	122.08 g.
Excreted Daily Av. 6596.00 g. Faeces Containing	1691.87 g.	86.47 g.	461.85 g.	927.66 g.	28.43 g.
Digested	1993.82 g.	86.93 g.	692.69 g.	1055.02 g.	93.65 g.
Per Cent. Digested	54.1 per ct.	50.0 per ct.	59.9 per ct.	52.7 per ct.	76.7 per ct.

OAT HULLS.

Digestible Nutrients 100 Pounds.

	Total Dry Matter	Dig. Protein.	Dig. Carbohydrates.	Dig. Ether Ext. or Fat.	Nutritive Ratio.
Oat Hulls. 100 Pounds	91.78	2.16	43.23	2.33	1:22:6
Ration Fed. 10 lbs. Oat Hulls	9.17	.21	4.32	.23	

OAT HULLS.

	TOTAL COMPOSITION 100 POUNDS.				
	Dry Matter.	Protein.	Crude Fiber.	Nitrogen Free Extract.	Ether Ext. or Fat.
Oat Hulls	91.78	4.32	28.75	49.27	3.04

It was determined, therefore, that this bull kept in condition and gained slightly in weight on a ration consisting of:

9.17 lbs. Dry matter.
.21 lbs. Dig. protein.
4.32 lbs. Dig. carbohydrates.
.23 lbs. Fats.
Having a nutritive ration of 1:22:6.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION

BULLETIN No. 169. AUGUST, 1912.

COW-TESTING ASSOCIATIONS.

By G. H. Hibberd and Guy E. Wolcott.

Introduction.

According to the last census 79.4 per cent. of the farms in Maryland were keeping dairy cows. The total number of dairy cows was 166,859, valued at $5,580,000. This gives an average value per cow of $33.40. As few of these farms were keeping herd records it is difficult to determine the average annual production per cow; but from the information that is available, 3,800 pounds of milk and 160 pounds of butter fat would seem to be a fair average. This is probably a liberal estimate, as the average annual production of the entire country is not more than 150 pounds of butter fat. If the average production in the State of Maryland might be increased to 5,000 pounds or milk or 200 pounds of fat per year; and the milk sold at 15 cents per gallon, it would increase the yearly income from dairy products by $3,484,015. This increased production can easily be made by eliminating from the herd all cows that are not profitable, by better methods of feeding and raising practically all of the feed on the farm.

The most satisfactory way to find the unprofitable cow is to keep a yearly record of milk and fat production, and the cost of feed consumed. One cow may start her period of lactation with a large flow of milk; but the per cent. of fat may be low, the flow of milk may decrease rapidly after five or six months; she may consume more feed than her production requires, thereby gaining in weight. Such a cow is quite sure to be unprofitable. A dairy cow should not gain perceptably in weight until the latter part of her milking period. Another cow may begin her lactation period with a moderate flow of milk, the fat percentage may be high, she may keep up a good flow to the end of her period, not using any of the feed consumed for the production of body fat. The latter cow is the more economical; but without a record of the cost of production, it is difficult to know which one is kept at a profit and which one is kept at a loss.

The cow-testing associations that are being organized by the Maryland Agricultural Experiment Station, assisted by the Dairy Division of the United States Department of Agriculture, are designed to increase the annual production of the dairy herds throughout the State, by keeping records of milk and fat production, and the cost of feed consumed. The object is to find the unprofitable cows, to introduce better methods of feeding, and to give advice and assistance in the care and management of dairy cattle, and the production of dairy products.

The associations organize themselves according to the articles and by-laws published by the Dairy Division. Each member of the association pays a membership fee of twenty-five cents, and one dollar per year for each cow tested. He also boards the tester who visits his farm one day each month.

The tester, who is usually an agricultural college graduate, arrives at the farm in the afternoon. That evening he weighs and takes a sample of each cow's milk. The next morning he again weighs and samples the milk of each cow. When the morning milking is finished he tests the samples of milk for fat according to the Babcock method. While at the farm the tester weighs the feed consumed by each cow, and estimates the cost. He also determines the value of the milk or fat. From thse results he calculates the profit or loss for the month. Further than this he calculates the returns yielded for one dollar expended for feed; also the cost of producing 100 pounds of milk, and the cost of producing one pound of butter fat for that month. He leaves a duplicate of his findings with the farmer, and proceeds to the next farm. When at the farm the tester gives advice and assistance in the care and management of dairy cattle, calf feeding, the kinds of crops best suited for milk production and the best methods of handling dairy products. The Maryland Agricultural Experiment Station is prepared to give personal attention to problems that may arise throughout the State, such as the building of silos, construction of barns, dairy buildings, ice houses; also the organization of cow-testing associations and breeders' associations.

The First Maryland Cow-Testing Association.

The First Maryland Cow-Testing Association was organized at Sparks, Baltimore county, in September, 1910, with a membership of 16. The members of the association have an aggregate of 360 cows. The following pages contain a record of the first year's work. The total value of the production of each cow in the association is given, the total cost of feed consumed, the profit or loss; and the cost of producing 100 pounds of milk, one pound of butter fat, and the returns for one dollar expended for feed is also calculated.

There is also a yearly summary for each herd in the association, giving the total value of the products, the cost of feed, and the total profit.

A careful study of the following records will give a clear idea of the great advantages to be derived from these associations. The

dairyman, by consulting his records, knows just exactly what every cow in his herd is worth to him.

Other Cow-Testing Associations.

The Baltimore County Association is now on its second years' work. Cow-testing associations have also been organized in both Harford and Cecil counties; and have resulted, so far, in awakening a realization by farmers that some cows are being kept at a loss; and that such animals should be discarded. Several other communities have under consideration the forming of cow-testing associations. The Experiment Station is ready to co-operate with any community in this work. The Station will assist in getting the organization started; and also give such help in supervision and the keeping of records as may be desired.

Many facts have been brought out by the year's work which are of great importance to the farmer. For instance, in the herd B it will be noted that one cow yielded a profit of $92.46 at a feed cost of $42.19; while another cow in the same herd made a profit of $47.96 at a cost of $41.60 for feed. Thus, one cow made nearly twice as much profit as the other at a very small increase in the cost of feed. This shows the wide variation in economical production between individuals of the same herd. Both cows yielded a profit; but one was so much more profitable than the other that the great possibilities to be derived from knowing the cost of production are apparent.

In herd D, the largest producing cow made a profit of $42.47 and consumed $45.41 worth of feed. The cow making the lowest production consumed $46.60 worth of feed; and was kept at a loss of $4.71. From the feed consumed, the profitable cow yielded 216.5 pounds of fat, while the cow kept at a loss yielded only 98.6 pounds of fat. It will also be noted that the feed consumed by the low producing cow was slightly greater than that consumed by the profitable cow. This variation is quite common in herds where no records are kept.

The cow making the largest production in herd F yielded 386.2 pounds of fat, the cost of feed being $51.78. In the same herd another cow yielded 197.4 pounds of fat at a feed cost of $48.88. The difference in the yield of fat between these two cows was 188.8 pounds, while there was only a difference of $2.90 in the cost of feed consumed. The economy of production is brought out by this comparison; and is one of the valuable lessons to be learned from the results of this cow-testing association. The same point of economical production is brought out in herd G, where there is a difference in profit of $68.47, while the difference in the cost of feed is only $2.30.

Not only is it pointed out that there are many cows that were being kept at a loss, but also that there is a great variation in the economy of production between cows that yield a profit. The results show conclusively that the cheapest production is made by the large yielding cows. After the needs of the body are supplied the milk and fat are produced most cheaply. The greater the proportion of the feed used for milk and fat production, the cheaper will be the cost of production.

During the year eighteen cows were disposed of as unprofitable. The object of the association is to identify the unprofitable cow, so that she may be discarded. Nearly every herd contains animals that would not be kept if there real value were known.

Individual Herd Records.

In addition to the three cow-testing associations, nine individuals are keeping records of their herds and mailing monthly reports to the Experimnet Station, where the records are placed on file.

The Station now has complete records of the herd of James W. Beacham, Jr., of Avondale, for two years. The herd summary for each year is given in the table below. When the record was started, in June, 1910, there were 26 cows in the herd. During the first year 9 cows were disposed of as unprofitable. This is slightly more than one-third of the herd. By consulting the tabulated comparison of the average yields it will be noticed that in the first year's work the estimated yield of milk for 12 months is 4441.9 pounds, containing 181.1 lbs. of fat. The average cost of feed per cow was $51.80, and the profit per cow, $22.93. The records for the second year show an average increase in milk production per cow of 2882.9, with a fat increase of 128.6 pounds per cow. The increased value of the product per cow was $72.42, while the price of milk was only 2.3 cents higher per gallon. The average profit per cow for the second year was $76.79, an increase of $53.86.

It will also be noted that the returns for $1.00 expended for feed increased 58 cents during the second year. The cost of production is also materially lower, there being a difference of 4.5 cents in the cost of producing one pound of fat, and a difference of 11 cents in the cost of producing 100 pounds of milk.

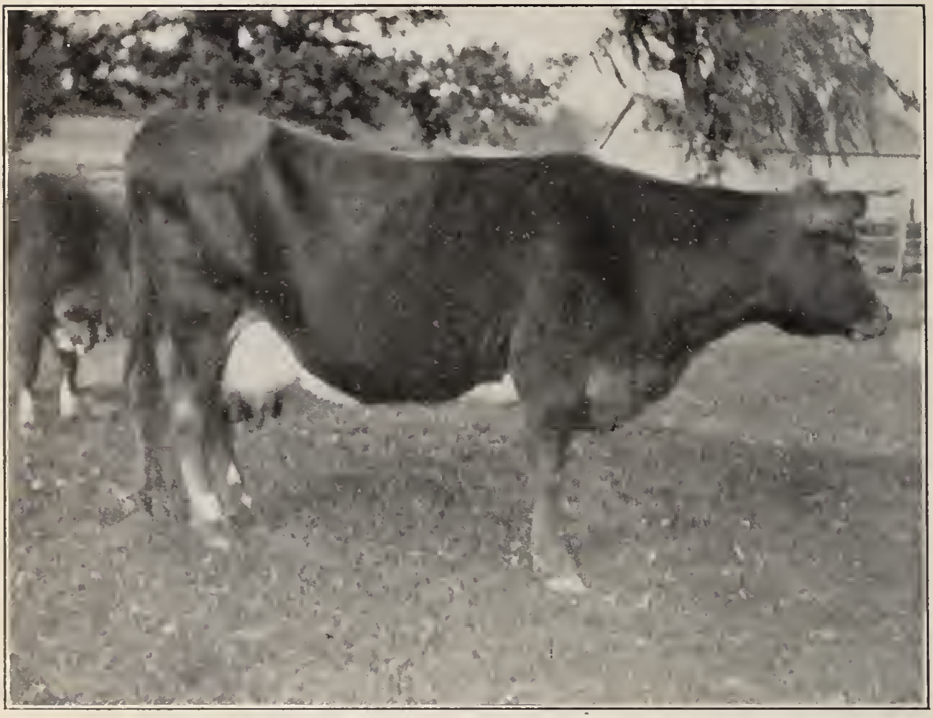
The striking increase in the profits for the second year are due to the elimination of unprofitable cows during the first year.

RECORD OF JAMES W. BEACHAM, JR'S. HERD FOR TWO YEARS.

Estimated Average for 12 Months	Milk lbs.	Fat lbs.	Price per gal	Value	Cost of Feed	Profit	Returns for $1.00 exp'd for feed	Cost of Producing 1 lb. of fat	Cost of Producing 100 lbs. milk
			Cents					Cents	
First Year	4441.9	181.1	14.4	$74.73	$51.80	$22.93	$1.44	28.5	$1.17
Second Year	7323.8	309.7	16.7	$ 147.05	$70.29	$76.79	$2.02	24.3	$1.06
Gain of Second Year over First	2882.9	128.6	2.3	$72.32	$18.49	$53.86	$0.58	4.5	$0.11

RECORD OF HERD B.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Butter Fat, Cents.	Value of Butter Fat.	Pounds of Feed Consumed. Hay.	Green Corn and Sorghum.	Pasture—Months.	Short Corn.	Bran.	Distiller's Grains.	Stover.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	4	7-12-'10	6239	4.4	276.9	.37	$100.12	1350	710	7	1599	516	232	3450	$23.84	$17.75	$41.59	$58.53	$2.14	.15	.67
2	12	7	4- 9-'10	8034	4.7	380.5	.36	134.83	1350	710	7	1632	520	206	3100	23.84	18.35	42.19	92.64	3.20	.11	.53
3	12	10	4-19-'10	6210	4.8	303.6	.36	109.45	1350	710	7	1729	566	232	3450	23.84	19.45	43.29	66.16	2.30	.14	.70
4	1	----	----------	198	7.1	14.1	.35	4.92	----	225	1	----	----	----	----	1.59	------	1.59	3.33	3.10	.11	.80
5	12	7	9-23-'10	5549	4.4	244.8	.37	89.56	1350	485	7	1514	566	232	3450	23.85	17.75	41.60	47.96	2.15	.17	.75
6	10	2	10-28-'10	5006	4.7	237.4	.36	85.71	1350	350	5	1684	566	232	3450	21.05	18.65	39.70	46.01	2.16	.17	.80
7	12	7	10-25-'10	5870	5.0	295.6	.36	107.34	1350	710	7	1719	566	232	3450	23.85	19.45	43.30	64.04	2.48	.14	.74
8	2	2	2-17-'11	1490	4.3	62.8	.39	24.50	200	----	1	363	180	87	1800	4.20	4.90	9.10	15.40	2.69	.14	.61
Totals for Testing Period				38596	4.7	1815.7	36.1	$656.43	8300	3900	42	10240	3480	1453	22150	$146.06	$116.30	$262.36	$394.07	$2.50	.144	.679
Est. Average per Cow for 12 Donths				6433	4.7	303.	36.1	$109.41	1383	650	7	1707	580	242	3692	$24.34	$19.39	$43.73	$65.68	$2.50	.144	.679



Cow in Herd B. Record for one year, milk 8034. lbs., butter fat 380.5 lbs.

RECORD OF HERD C.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Butter Fat, Cents.	Value of Butter Fat.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Mo's.	Stover.	Sucrene.	Shorts.	Bran.	Corn Chop.	Gluten.	Dist. Grains.	Oats.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	9	2-9-'10	4079	4.5	182.0	38.5	$70.14	920	6680	7	590	157	45	402	258	105	320	106	62	$24.23	$17.70	$41.93	$28.21	$1.67	.23	1.03
2	12	8	June	3906	4.0	154.1	40.0	61.78	915	5855	7	1145	166	45	460	418	441	114	40	40	22.53	19.95	42.48	19.30	1.43	.27	1.09
3	12	8	June	5058	5.0	254.1	39.7	100.62	915	6080	7	1150	166	45	507	375	517	158	57	42	23.23	22.35	45.58	55.04	2.20	.18	.90
4	12	8	June	4146	3.6	148.7	42.7	63.70	915	4730	7	1150	166	45	352	364	387	114	40	13	21.23	17.30	38.53	25.17	1.65	.25	.93
5	12	9	Mar.	3486	4.2	144.2	41.0	59.01	915	6680	7	1150	157	45	448	375	483	158	57	33	24.13	20.75	44.88	14.13	1.32	.31	1.29
6	12	7	May	4676	4.8	227.4	40.2	91.45	915	6680	7	1150	166	45	491	364	532	136	46	90	24.13	24.05	48.18	43.27	1.90	.21	1.02
7	12	6	May	3944	4.9	193.7	40.8	79.07	915	5330	7	1150	166	45	424	364	440	127	52	28	22.08	19.45	41.53	37.54	1.90	.21	1.05
8	12	4	Mar.	4761	4.7	228.4	39.4	89.75	915	6680	7	1150	157	45	497	300	492	189	73	70	24.03	22.25	46.28	43.47	1.95	.20	.95
9	12	4	Feb.	5681	4.5	255.3	39.6	100.93	915	6680	7	1150	157	45	572	375	582	189	73	69	24.13	24.85	48.98	51.95	2.06	.19	.88
10	12	7	Sept. 1	5278	4.5	233.0	40.4	94.15	915	6680	7	1150	176	45	492	364	500	143	52	46	24.18	21.35	45.48	48.67	2.08	.20	.87
11	2	--	----------	468	4.8	22.5	34.6	7.77	----	360	2	225	140	45	50	150	----	----	----	---	2.88	4.55	7.43	.34	1.04	.33	1.61
12	12	8	Aug. 1	3423	4.3	148.4	41.8	62.00	915	5180	7	1150	112	90	384	364	409	137	45	9	21.93	17.85	39.78	22.22	1.55	.27	1.16
13	12	8	June	4750	4.6	218.2	40.3	87.83	915	6680	7	1150	166	45	554	375	559	167	68	66	24.13	24.20	48.33	39.50	1.82	.22	1.05
14	12	10	May	4443	3.5	155.7	43.5	67.53	915	5180	7	1150	166	45	390	375	456	157	62	13	22.63	20.05	42.68	24.85	1.58	.27	.96
15	12	6	May	4760	4.5	213.3	89.8	85.27	915	6080	7	1150	166	45	512	375	508	150	57	45	23.23	22.25	45.48	39.79	1.89	.21	.95
16	12	6	Aug.	3720	4.0	148.9	40.4	60.43	915	5180	7	1150	166	45	464	364	443	114	40	41	22.53	20.05	42.58	17.85	1.43	.29	1.15
17	12	7	Aug.	5077	3.7	187.6	42.4	79.61	915	5580	7	1150	166	45	386	375	483	173	68	28	22.83	20.70	43.53	36.08	1.83	.23	.86

RECORD OF HERD C.—(Continued.)

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Butter Fat, Cents.	Value of Butter Fat.	Pounds of Feed Consumed. Hay.	Silage.	Pasture Months.	Stover.	Sucrene.	Shorts.	Bran.	Corn Chop.	Gluten.	Distiller's Grains.	Oats.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
18..........	12	8	Nov.	4727	4.1	192.3	41.3	$79.47	915	6680	7	1150	157	45	561	375	541	173	62	69	$24.13	$24.10	$48.23	$31.24	$1.66	.25	1.03
19..........	12	6	Aug.	4022	4.2	169.4	40.5	68.76	915	4730	7	1150	166	45	470	364	455	121	45	41	22.53	20.40	42.93	25.83	1.60	.25	1.07
20..........	12	9	July	6255	4.0	246.1	41.3	101.26	915	6230	7	1150	166	45	570	364	496	114	40	26	23.43	23.00	46.43	54.83	2.20	.19	.75
21..........	12	9	July	3962	4.1	164.1	41.2	67.82	915	6680	7	1150	157	45	448	375	480	157	62	33	24.13	20.70	44.83	22.99	1.51	.27	1.13
22..........	11	7	Sept. 27	3501	3.8	132.4	42.3	56.00	915	4730	6	1025	76	---	375	375	527	141	62	13	19.89	16.95	36.84	19.16	1.51	.28	1.05
23..........	11	7	Sept. 1	4321	4.1	180.0	40.4	72.71	915	6680	6	1025	72	---	513	375	532	171	68	50	22.79	21.05	43.84	28.87	1.65	.24	1.03
24..........	10	6	Oct. 25	4925	4.3	212.7	40.8	86.68	915	6320	5	1025	17	---	485	225	555	179	78	57	21.25	19.05	40.30	46.38	2.14	.19	.82
25..........	3	8	5-29-'11	2284	3.7	84.1	37.2	31.22	----	2400	3	----	26	---	234	----	139	----	----	90	5.75	7.00	12.75	18.47	2.45	.15	.56
Totals for Testing Period.				105653	4.25	4496.6	40.6	$1824.96	21050	140765	162	25735	3553	990	11041	8388	11062	3602	1352	1074	$537.91	$491.90	$1029.81	$795.15	$1.77	.229	.974
Es. av. per Cow for 12 Mo's				4560	4.2	194.1	40.6	$78.76	909	6075	7	1111	110	428	476	362	477	155	59	46	$23.22	$21.23	$44.45	$34.31	$1.77	.229	.974

RECORD OF HERD D.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Bran.	Sucrene.	Gluten.	Corn.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	6	8- 5	4273	4.2	181.1	15.0	$73.52	1815	2500	6	323	195	262	1790	219	$25.55	$18.15	$43.70	$29.82	$1.69	.23	1.02
2	12	13	8- 3-'10	4931	3.9	195.6	14.4	82.23	1815	2500	6	312	195	263	890	219	25.55	18.95	44.50	37.73	1.85	.23	.91
3	12	4	8-27-'10	3201	3.7	121.1	14.8	55.30	1815	2500	6	323	195	262	830	219	25.55	18.15	43.70	11.60	1.27	.36	1.36
4	12	4	5-10-'10	4103	4.3	175.4	14.7	70.32	1815	2500	6	293	180	245	690	195	25.55	18.15	43.70	26.62	1.61	.25	1.06
5	12	3	4- 1-'10	3575	4.8	174.1	14.8	61.76	1815	2500	6	293	180	243	690	195	25.55	17.32	42.87	18.89	1.44	.25	1.20
6	12	6	3- 7-'10	5272	4.1	216.5	14.4	87.88	1860	2500	6	323	195	262	880	244	25.95	19.46	45.41	42.47	1.96	.21	.86
7	12	----	----------	3559	4.6	165.4	14.2	58.66	1815	2500	6	292	180	518	405	----	25.55	14.42	39.97	18.69	1.46	.24	1.13
8	7	9	5-31-'10	1848	4.3	79.6	15.6	33.50	1565	2500	6	323	195	262	430	60	16.85	14.05	30.90	2.60	1.08	.38	1.67
9	12	----	----------	4356	3.7	162.5	14.3	72.11	1665	2500	6	118	111	87	1180	354	24.00	16.09	40.09	32.02	1.80	.25	.92
10	12	10	4-10-'10	3318	4.6	152.0	14.6	56.16	1815	2500	6	233	105	202	1730	354	25.65	18.64	44.29	11.87	1.27	.26	1.33
11	12	12	----------	3798	4.2	158.5	14.5	63.99	1665	2500	6	80	30	50	1125	354	24.00	14.02	38.02	25.97	1.64	.25	1.03
12	12	10	10-27-'10	3430	3.8	130.9	15.7	62.46	1315	1085	6	135	----	135	1170	354	25.25	15.60	40.85	21.61	1.52	.32	1.19
13	12	12	12-16-'10	4498	3.8	169.0	14.5	76.36	1415	2500	6	80	30	50	1016	354	24.00	13.92	37.92	38.44	2.01	.22	.84
14	12	10	2- 1-'11	3208	4.9	158.6	14.9	56.01	750	2400	6	118	105	87	990	285	26.45	14.64	41.09	14.92	1.37	.26	1.29
15	12	12	11-18-'10	4488	3.8	168.4	14.6	76.71	1415	2500	6	130	30	100	1170	354	25.00	15.32	40.32	36.39	1.90	.24	.90
16	12	12	11- 3-'10	3367	4.4	148.1	1.56	61.05	1715	2500	7	117	----	117	1170	354	25.35	15.05	40.40	20.65	1.50	.27	1.20

RECORD OF HERD D—(Continued).

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Bran.	Sucrene.	Gluten.	Corn.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
17	12	12	----------	3413	4.1	139.6	14.4	56.85	1815	2500	6	323	195	262	890	269	$25.55	$18.15	$43.70	$13.15	$1.30	.31	1.28
18	12	12	----------	4068	5.0	203.3	15.5	72.83	1815	2500	6	323	195	262	1170	354	25.55	22.65	48.20	24.63	1.51	.24	1.19
19	12	12	----------	2478	4.0	98.6	14.5	41.89	1815	2500	5	242	213	240	1210	354	25.97	20.63	46.60	4.71	.89	.48	1.88
20	12	12	----------	3612	4.1	147.8	14.0	58.88	1815	2500	6	323	195	262	510	60	25.55	14.45	40.00	18.88	1.47	.27	1.11
21	12	4	----------	3119	5.0	156.6	15.0	54.26	1915	2500	6	253	105	662	180	135	25.30	13.59	38.89	15.37	1.39	.25	1.29
22	12	4	----------	4619	4.6	213.9	14.5	78.05	1815	2500	6	323	195	262	910	294	25.55	20.35	45.90	32.15	1.70	.20	.99
23	12	4	----------	4421	3.3	171.8	14.4	74.13	1665	2500	6	118	105	87	1135	354	24.05	15.84	39.89	34.24	1.86	.23	.90
24	12	4	----------	4804	4.3	205.5	14.2	79.57	1815	2500	6	323	195	262	790	195	25.55	18.15	43.70	35.87	1.82	.21	.91
25	12	4	----------	3811	4.3	160.5	14.5	64.95	1115	2500	6	118	105	87	1050	354	23.50	15.49	38.99	25.96	1.66	.24	1.03
26	12	4	----------	4474	4.9	216.0	14.7	77.10	1550	2500	6	293	280	247	880	285	25.00	19.52	44.52	32.58	1.73	.21	1.00
27	12	4	----------	4885	4.0	195.5	14.3	81.17	1815	2500	6	323	195	262	670	165	25.55	17.05	42.60	38.57	1.90	.22	.87
28	11	3	----------	3524	4.6	161.3	15.3	62.62	1815	2500	5	242	212	235	1210	354	23.98	20.62	44.60	18.02	1.40	.28	1.28
29	7	2½	1-11-'11	382	5.4	21.0	14.8	6.58	765	1500	4	----	----	----	740	294	13.80	8.60	22.40	15.82	2.91	1.06	5.86
30	5	--	----------	1430	4.7	66.9	14.6	24.50	250	500	4	----	----	----	360	135	8.70	4.10	12.80	11.70	1.93	.20	.90
Totals for Testing Per'd			28.5	110265	4.27	4715.1	----	$1881.40	47850	70485	175	6697	4116	6275	27861	7716	$719.40	$491.12	$1210.52	$670.88	$1.55	.256	1.10
Est. av. per Cow for 12 Months				3868.9	4.27	165.4	----	$66.01	16789	24731	6 1	234 9	144.4	220.1	977.5	270.7	$25.24	$17.23	$42.47	$23.54	$1.55	.256	1.10

RECORD OF HERD E.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Butter Fat, Cents.	Value of Butter Fat.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Months.	Bran.	Sucrene.	Gluten.	Stover.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	9	10-26-'10	5400	4.5	243.9	.40	$96.59	1230	5775	4	657	512	650	800	33	$24.05	$26.43	$50.48	$46.11	$1.91	.21	.93
2	3	26	----------	885	4.3	37.6	.38	14.25	-----	750	3	315	210	105	-----	----	3.13	8.25	11.38	2.87	1.25	.30	1.30
3	12	12	11- 8-'10 1- 7-'11	4484	5.3	235.9	.40	92.53	1230	5375	4	722	507	623	800	33	23.30	25.48	48.78	43.75	1.90	.21	1.09
4	12	12	1-10-'10 7- 8-'11	4497	4.7	209.8	.39	81.61	1230	5350	4	714	624	503	270	33	22.30	23.78	46.08	35.53	1.77	.22	1.02
5	12	7	8-20-'10	8253	4.7	386.2	.39	149.13	1230	5675	5	777	713	613	800	33	23.63	28.15	51.78	97.35	2.88	.13	.63
6	3	15	----------	711	4.7	34.6	.38	13.06	-----	750	2	315	210	105	-----	----	3.13	8.25	11.38	1.68	1.15	.32	1.60
7	12	7	1-30-'10 6-13-'11	5040	5.2	261.7	.39	101.43	1250	5325	5	714	624	505	270	33	22.30	23.78	46.08	55.35	2.2[illegible]	.17	.91
8	12	7	7-29-'10 2-28-'11	4072	5.6	226.3	.39	87.11	1230	5178	5	718	613	517	800	----	23.63	23.95	47.58	39.53	1.8[illegible]	.21	1.17
9	12	5	1-27-'10 2- 7-'11	7073	4.8	339.7	.39	130.52	1230	5025	5	812	707	613	800	33	23.63	28.15	51.78	78.74	2.5[illegible]	.15	.72
10	12	8	2- 6-'10 4-29-'11	3610	5.5	197.4	.39	76.99	1230	5325	5	745	651	546	800	33	23.63	25.25	48.88	28.11	1.5[illegible]	.25	1.33
11	12	5	8- 6-'10 12-23-'11	4650	5.9	274.1	.37	102.01	1230	5675	5	770	665	559	800	33	23.63	25.85	49.48	52.53	2.0[illegible]	.18	1.06
12	12	6	2- 2-'10	4836	5.7	274.4	.39	106.75	1230	5675	5	718	613	509	800	33	23.63	28.15	51.78	54.97	2.0[illegible]	.19	1.07
13	3	16	10- 8-'10	280	4.6	12.8	.40	5.16	-----	750	2	175	775	105	-----	----	2.93	4.79	7.72	2.56	.6[illegible]	.60	2.80
14	12	12	1-8-'11	5577	4.3	240.9	.38	92.92	1250	3925	5	624	624	415	270	33	22.30	23.78	46.08	46.84	2.02	.19	.83
Totals for Testing Period	11.75			59368	5.01	2975.3	38.6	$1150.06	13570	60553	59	8776	8048	6368	7210	330	$265.22	$304.04	$569.26	$580.80	$2.02	.191	.96
Est. av. per Cow for 12 Months				5053	5.01	253.2	38.6	$97.88	1155	5153	5.02	747	685	542	614	28	$22.57	$25.88	$48.45	$49.43	$2.02	.191	.96

Cow in Herd E. Record for one year, milk 8253.0 lbs., butter fat 386.2 lbs.

RECORD OF HERD F.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Bran.	Sucrene.	Gluten.	Beet Pulp.	Corn.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	--	Aug.	3254	4.2	137.4	17.0	$64.33	300	2700	7	420	260	461	456	556	--	$18.65	$18.79	$37.44	$26.89	$1.72	.27	1.15
2	12	--	Nov. 1	6428	4.0	259.0	17.1	128.36	300	3000	7	580	320	535	500	710	--	20.05	24.41	44.46	83.90	2.88	.17	.69
3	8	--	--	4412	5.2	229.0	16.7	85.98	300	1050	7	620	600	295	270	350	--	12.41	20.93	33.34	52.64	2.58	.15	.75
4	9	--	Nov. 1	4458	4.2	185.1	17.5	90.99	150	3000	4	430	150	485	500	700	60	15.50	20.65	36.15	54.84	2.52	.20	.81
5	12	--	Apr.	3344	4.7	159.6	16.3	63.85	150	3000	7	530	380	180	36	246	60	14.30	15.95	30.25	33.60	2.11	.19	.91
6	5	--	--	960	4.3	42.1	17.1	19.11	300	1200	3	360	240	163	--	90	--	6.50	10.84	17.34	1.77	1.10	.50	1.82
7	5	--	--	3557	3.8	136.8	16.0	66.16	--	900	4	410	230	120	--	180	60	5.50	11.80	17.30	48.86	3.83	.14	.48
8	12	--	Mar.	4255	4.6	193.0	16.3	80.59	150	2700	7	680	380	330	--	360	60	12.95	20.20	33.15	47.44	2.43	.17	.78
9	12	--	Jan.	4139	4.2	171.2	16.6	79.90	300	3000	7	740	440	421	190	434	60	15.85	24.99	40.84	39.16	1.97	.24	.99
10	12	--	Mar.	3765	4.9	182.4	16.7	73.29	150	3000	7	550	350	420	350	590	60	16.70	22.25	38.95	34.34	1.88	.21	1.04
11	1	--	--	45	--	--	--	--	--	--	1	60	--	--	--	--	--	1.00	1.56	2.56	.81	.68	.57	5.69
12	1	--	--	252	5.7	14.4	17.2	5.04	--	--	1	60	--	--	--	--	--	1.00	1.56	2.56	2.48	1.97	.18	1.01

RECORD OF HERD F—Continued.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay	Stover.	Pasture—Months	Bran.	Sucrene.	Gluten.	Beet Pulp.	Corn.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
13	3	--	----------	2047	3.6	73.2	16.0	$38.06	-----	-----	4	260	----	----	----	----	---	$3.43	$6.57	$10.00	$28.06	$3.08	.14	.49
14	9	--	----------	1932	5.0	95.1	17.4	39.03	150	3150	4	275	85	340	230	410	60	11.99	12.66	24.56	14.47	1.60	.26	1.28
15	12	--	Mar.	4651	4.5	212.9	16.7	90.60	150	3150	7	620	380	360	250	410	60	15.55	21.60	37.15	53.45	2.45	.18	.82
16	12	--	Apr.	3850	4.3	167.8	16.9	74.69	150	3225	7	600	380	350	170	430	60	14.85	21.30	36.15	38.54	2.07	.22	.94
17	12	--	Mar.	4111	4.5	186.0	16.9	80.98	150	3000	7	560	380	385	420	536	60	17.70	22.05	39.75	41.23	2.05	.21	.97
18	12	--	----------	5580	4.1	229.2	16.5	107.22	275	3000	7	605	325	545	500	700	60	19.48	25.10	44.58	62.64	2.14	.19	.80
19	5	--	----------	2363	4.7	110.5	16.0	43.96	----	900	4	410	290	270	----	760	---	5.50	11.10	16.60	37.36	2.64	.15	.71
20	11	--	----------	4183	4.0	164.4	16.8	82.08	30	3000	6	510	280	475	510	650	30	18.65	22.39	41.04	41.04	2.00	.25	.98
Totals for Testing Period			14.75	67584	4.4	295.41	16.7	$1315.97	327	[illegible]957	108	9280	5850	6135	4706	8112	670	$247.47	$336.70	$584.17	$731.80	$2.25	.20	.87
Est. av. per Cow for 12 Months				4583	4.4	200.3	16.7	$89.22	2[illegible]	[illegible]912	7.18	630	397	416	326	550	45	$16.80	$22.82	$39.62	$49.60	$2.25	.20	.87

RECORD OF HERD G.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture.	Bran.	Sucrene.	Barley.	Cottonseed.	Gluten.	Corn.	Stover.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	--	--	4674	4.9	232.3	15.7	$85.61	1165	6120	5	922	305	297	273	311	361	2250	$23.80	$29.95	$53.75	$31.86	$1.59	.23	1.14
2	12	--	--	4633	5.0	325.8	16.3	87.52	1165	6120	5	965	305	297	288	332	382	2250	23.80	29.65	53.45	34.07	1.66	.24	1.37
3	12	--	--	4568	4.6	206.4	17.1	91.08	1165	6120	5	820	215	297	288	332	332	2250	23.80	26.50	50.30	40.78	1.83	.25	1.10
4	12	--	--	4354	4.3	186.2	17.0	86.13	1165	6120	5	702	305	297	258	250	250	2250	23.80	24.05	47.85	38.28	1.80	.26	1.10
5	12	--	--	6539	5.3	342.3	16.4	123.99	1165	6120	5	965	305	297	288	332	382	2250	23.80	29.65	53.45	70.54	2.33	.16	.83
6	5	--	--	1182	5.9	69.3	16.6	22.84	550	2430	2	395	305	228	135	99	99	750	9.20	14.85	24.05	-1.21	.95	.35	2.04
7	1	--	--	162	8.0	13.0	14.0	2.64	--	--	1	45	90	--	--	--	--	--	1.00	1.65	2.65	-.01	1.00	.20	1.67
8	1	--	--	219	7.4	16.2	14.0	3.57	--	--	1	45	90	--	--	--	--	--	1.00	1.65	2.65	.92	1.35	.16	1.21
9	8	--	--	3569	5.4	191.8	17.6	73.09	1015	5445	1	601	275	324	228	209	209	2250	18.32	22.33	40.65	32.44	1.79	.21	1.14
10	9	--	--	3400	4.3	145.0	17.0	67.15	1165	6120	2	702	305	297	258	250	250	2250	20.80	24.05	44.85	22.30	1.49	.31	1.32
11	12	--	--	5268	5.7	305.4	16.0	98.11	1165	6120	5	1025	305	297	288	332	380	2250	23.80	29.65	53.45	44.66	1.85	.18	1.12
12	12	--	--	5149	4.5	234.5	16.0	95.76	1165	6120	5	1025	305	297	283	332	282	2250	23.80	29.65	53.45	42.31	1.80	.23	1.04
13	12	--	--	3387	4.1	132.8	16.0	62.52	1165	6120	5	945	305	297	258	291	339	2250	23.80	27.35	51.15	11.37	1.23	.39	1.56
14	12	--	--	4678	4.8	225.7	16.9	92.18	1165	6020	5	920	--	383	358	393	392	2250	23.80	28.00	51.80	40.38	1.78	.23	1.11
15	12	--	--	4257	6.1	259.4	16.3	80.31	1165	6120	5	1025	344	303	282	332	363	2250	23.80	29.65	53.45	26.86	1.51	.21	1.26
16	12	--	--	4907	5.0	246.0	16.3	92.50	1165	6120	5	1025	297	288	332	382	305	2250	23.80	29.65	53.45	59.05	1.71	.22	1.09
17	12	--	--	7093	3.9	276.5	16.2	133.29	1165	6120	5	965	305	297	288	332	380	2250	23.80	29.65	53.45	79.84	2.50	.19	.75

RECORD OF HERD G.—(Continued).

No. of Cow	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Months.	Bran.	Sucrene.	Barley.	Cottonseed.	Gluten.	Corn.	Stover.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
18	12	--		3464	4.8	165.1	16.8	$67.02	1165	6120	5	965	305	297	288	332	382	2250	23.80	29.65	53.45	13.57	1.26	.32	1.55
19	12	--		4891	4.8	233.9	16.3	92.33	1165	6120	5	965	305	297	288	332	382	2250	23.80	29.65	53.45	38.88	1.74	.23	1.09
20	12	--		6699	4.1	274.5	15.5	120.25	1165	6120	5	965	305	297	288	332	382	2250	23.80	29.65	53.45	66.80	2.26	.20	.80
21	12	--		6287	4.5	285.3	16.1	117.57	1155	6120	5	965	305	297	258	332	382	2250	23.80	29.65	53.45	64.12	2.21	.19	.84
22	12	--		3859	4.0	153.1	17.7	76.72	1165	6120	5	734	209	239	288	291	291	2250	23.80	24.14	47.94	28.78	1.60	.31	1.25
23	12	--		5651	4.9	273.1	16.1	105.86	1165	6120	5	965	305	297	288	332	382	2250	23.80	29.65	53.45	52.41	1.99	.20	.94
Totals for Testing Period			20	98884	4.8	4793.6	16.4	$1878.04	22535	124055	97	177065	5485	6517	5808	6459	6917	45756	$478.72	$580.32	$1059.04	$819.00	$1.77	.22	1.07
Est. av. per Cow for 12 Months				4944	4.8	239.7	16.4	$93.90	1127	6203	5	885	274	326	290	323	346	2288	$23.94	$29.02	$52.96	$40.95	$1.77	.22	1.07

RECORD OF HERD H.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Stover.	Silage.	Pasture—Months.	Ajax.	Oats.	C. S. Meal.	Gluten.	Bran.	Beet Pulp.	Hay.	Hammond.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	10	7- 6-'11 7- -'10	4347	4.3	186.9	16.3	$82.18	1230	5480	5	180	60	183	686	623	279	360	60	$19.90	$25.89	$45.79	$36.39	$1.79	.25	1.05
2	12	14	8-15-'10	3901	4.5	173.9	16.6	75.32	1230	5480	5	180	60	183	686	503	274	360	45	19.90	25.24	45.14	30.18	1.67	.26	1.16
3	12	6	8- -'10	3583	4.1	145.6	17.	71.20	1230	5480	5	180	60	183	634	525	279	360	---	19.90	23.69	43.59	27.61	1.61	.30	1.21
4	12	8	5-11-'11 4- -'10	5293	4.3	228.5	16.0	98.20	1230	5480	5	180	60	183	716	683	279	360	60	19.40	27.84	47.24	50.96	2.09	.21	.89
5	12	8	4-20-'11 4- -'10	4493	4.3	192.3	15.5	81.25	1580	5430	5	180	60	164	544	903	174	360	30	18.70	25.04	43.74	37.59	1.86	.23	.97
6	12	5	6- -'10	5985	4.5	266.8	16.0	111.27	1230	5480	5	180	60	182	716	899	279	360	60	19.90	28.69	48.59	62.68	2.28	.18	.81
7	12	8	3-15-'11 2- -'10	4169	4.4	184.2	15.4	74.63	1180	6290	5	180	60	70	373	651	102	360	30	19.25	18.24	37.49	37.14	1.99	.20	.90
8	12	5	9- -'09	4452	4.6	206.5	16.4	84.61	1230	5480	5	180	60	183	791	603	379	360	15	19.90	25.74	45.64	38.97	1.85	.22	1.02
9	12	3	2- -'11 2- -'10	3914	4.	158.4	15.8	72.24	1230	6480	5	180	60	110	504	590	240	360	30	19.90	21.14	41.04	31.20	1.76	.26	1.05
10	12	5	11-15-'10 11- -'09	5654	4.5	255.3	16.5	108.61	1392	7040	5	145	---	164	783	718	363	360	---	20.70	27.34	48.04	60.57	2.26	.19	.85
11	12	11	12- 3-'10 1-10-'10	4616	4.2	193.4	16.3	87.55	1230	7680	5	140	---	41	686	681	321	360	30	19.90	25.19	45.09	42.46	1.94	.23	.98
12	12	12	4- -'11 3- -'10	3759	4.2	151.1	15.3	66.68	1580	4530	5	180	60	74	385	643	93	360	30	18.70	18.29	36.99	29.69	1.80	.24	.98
13	12	8	4- -'11 3- -'10	3449	4.2	146.2	15.3	61.23	1810	4930	5	180	60	99	496	731	111	360	30	18.70	21.29	39.99	21.24	1.54	.26	1.16
14	10	8	11-12-'10	3032	4.2	127.9	16.5	58.71	1170	5280	3	----	---	144	673	528	279	360	30	16.60	20.35	36.95	21.76	1.59	.29	1.22
15	10	8	11-12-'10	4156	5.6	232.4	16.8	81.39	1190	5280	3	----	---	165	711	695	334	360	30	16.70	23.75	40.45	40.94	2.00	.17	.97
16	12	8	11- -'10	6510	4.4	288.5	16.8	127.48	1310	6680	3	130	---	211	855	996	335	360	45	19.90	31.05	50.95	76.53	2.49	.18	.78
17	9	8	11-22-'10	5494	3.6	198.4	16.4	104.51	1050	4080	3	----	---	159	742	838	363	360	30	16.25	26.35	42.60	61.91	2.45	.22	.77

RECORD OF HERD H.—(Continued).

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Stover.	Silage.	Pasture—Months.	Ajax.	Oats.	C. S. Meal.	Gluten.	Bran.	Beet Pulp.	Hay.	Hammond.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
18	9	2	1-18-'11	2697	5.0	183.0	15.4	$51.23	1090	5180	3	----	---	143	615	488	249	360	30	$16.50	$19.40	$35.90	$15.33	$1.43	.27	1.33
19	7	12	2-10-'11	5106	3.5	182.1	16.0	94.00	1230	5400	3	----	---	101	568	76	252	360	30	17.10	20.95	38.05	55.95	2.47	.21	.74
20	1	--	----------	54	5.2	2.8	15.	.95	-----	100	10	----	---	----	-----	-----	----	----	---	1.40	------	1.40	-.45	.68	.50	.51
Totals for Testing Period			17.5	84664	4.3	3660.2	16.2	$1593.24	24422	105760	8.4	2395	660	2866	12163	12366	4929	6840	615	$359.20	$455.47	$814.67	$778.57	$1.95	.22	.96
Est. av. per Cow for 12 Months				4838	4.3	209.2	16.2	$91.04	1396	6015	4.8	137	38	164	695	707	282	391	35	$20.53	$26.02	$46.55	$44.49	$1.95	.22	.96

RECORD OF HERD I.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Sucrene.	Corn Sh.	Middlings.	C. S. Meal.	Dist. Grains.	Oats.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	--	----------	4078	5.7	232.1	17.0	$80.76	2595	2000	6	569	684	140	125	115	41	$29.71	$18.27	$47.98	$32.78	$1.68	.21	1.17
2	12	--	----------	2528	5.6	142.4	18.0	53.06	2595	2000	6	449	684	140	125	115	41	29.71	16 83	46.54	6.52	1.14	.32	1.84
3	12	--	----------	3697	4.6	170.2	15.0	64.22	2545	2000	6	297	252	----	80	115	41	29.21	8.56	37.77	26.45	1.76	.22	1.02
4	12	--	----------	3472	5.6	195.4	18.0	68.32	2595	2000	6	449	684	140	165	115	41	29.71	16.83	46.54	21.78	1.46	.24	1.34
5	12	--	----------	4071	4.5	186.0	14.7	70.18	2595	2000	6	319	594	140	165	115	41	29.76	16.37	46.13	24.05	1.53	.25	1.13
6	12	--	----------	2771	5.2	144.6	18.0	54.88	2493	2000	6	332	297	----	80	115	41	28.85	9.44	38.29	16.59	1.43	.26	1.38
7	12	--	----------	2868	5.2	148.1	14.6	49.05	2595	2000	6	359	549	140	85	70	41	29.76	14.97	44.73	4.32	1.10	.30	1.56
8	6	--	----------	705	4.4	31.1	17.7	14.53	1750	1200	2	330	210	----	----	----	----	17.25	5.84	23.09	-8.56	.63	.74	3.28
9	12	--	----------	4845	4.8	232.7	16.1	90.83	2595	2000	6	609	684	140	165	115	41	29.71	18.27	47.98	42.85	1.89	.21	1.00
10	12	--	----------	3145	5.4	171.9	17.5	63.90	2595	2000	6	397	684	140	165	115	41	30.25	16.65	46.90	17.00	1.36	.27	1.50
11	6	--	----------	3176	4.0	125.8	12.8	46.93	730	800	4	-----	132	----	80	115	41	13.30	4.50	17.80	29.13	2.64	.14	.56
Totals for Testing Period			10.00	35356	5.0	17803	----	$656.66	25685	20000	60	4110	5454	980	1235	1105	410	$297.22	$146.53	$443.75	$212.91	$1.48	.25	1.25
Est. av. per Cow for 12 Months				3536	5.0	178.0	----	$65.67	2569	2000	6	411	545	98	124	111	41	$29.72	$14.65	$44.37	$21.30	$1.48	.25	1.25

RECORD OF HERD J.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture.	Sucrene.	Middlings.	Cottonseed.	Bran	Corn.	Barley	Oats.	Alfalfa Meal.	Gluten.	Dis. Grains.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	3	5- 1-'10	5091	5.2	264.2	16.2	$96.03	3765	3930	6	749	263	119	63	312	124	49	454	243	---	$32.15	$29.15	$61.30	$34.73	$1.57	.24	1.20
2	12	12	4-15-'10	4614	3.8	174.8	15.2	82.52	2225	3630	6	699	263	279	63	282	107	41	432	285	---	31.45	27.80	59.25	23.27	1.39	.34	1.28
3	12	2	5- 1-'10	2808	5.4	151.7	17.1	56.08	2365	4230	6	670	263	119	69	203	326	46	305	191	---	32.15	26.40	58.55	-2.47	.96	.38	2.08
4	12	8	12- 1-'10	3934	4.0	157.3	16.5	74.98	2365	3930	6	637	210	108	32	307	123	47	200	277	236	32.15	26.20	58.35	16.63	1.29	.37	1.49
5	3	--	----------	603	6.1	36.7	17.0	11.96	420	1800	2	284	143	29	63	-----	----	----	----	----	---	7.90	6.80	14.70	-2.74	.81	.40	2.44
6	12	8	4-15-'10	4111	5.0	205.6	16.5	76.53	2365	3930	6	704	263	129	63	303	121	46	200	253	117	32.15	28.10	60.25	16.28	1.26	.29	1.52
7	12	2	6-24-'10	4222	5.0	212.0	16.3	80.05	2365	3930	6	812	263	119	63	379	149	45	200	196	234	32.15	27.20	59.35	20.70	1.35	.38	1.42
8	1	--	----------	162	5.3	8.6	16.0	3.01	-----	600	1	75	38	8	----	-----	----	----	----	----	---	1.90	1.60	3.50	-.49	.86	.41	2.15
9	12	12	1-26-'10	3344	3.4	112.8	17.0	66.13	2365	3930	6	693	263	119	63	299	119	45	200	211	126	32.15	27.10	59.25	6.88	1.11	.53	1.78
10	12	5	1- 6-'10	3784	5.5	205.9	16.1	70.64	2565	4230	5	680	263	119	63	299	119	45	200	271	217	32.05	27.65	59.70	10.94	1.17	.29	1.57
11	12	10	3- 5-'10	4777	4.2	200.2	16.2	89.91	2365	3930	6	682	263	119	63	299	119	45	200	196	235	32.15	27.20	59.35	30.56	1.54	.30	1.24
12	12	6	3- 5-'10	7179	4.2	297.8	16.0	134.07	2365	3930	6	774	263	119	63	328	132	52	200	312	281	32.15	30.56	62.70	71.37	2.17	.21	.88
13	8	9	7-13-'10	2123	4.1	37.5	17.2	42.76	2155	3930	2	582	263	119	63	299	119	45	200	118	106	24.65	32.35	48.00	-5.24	.89	.55	2.26
14	12	8	6- 6-'10	6505	3.3	213.4	16.5	124.39	2365	3930	6	776	263	119	63	328	127	52	200	312	301	22.15	30.55	62.70	61.69	1.99	.29	.97
15	12	4	9-10-'10	4026	4.5	180.3	16.0	74.65	2365	3930	6	654	263	119	63	299	119	45	200	196	235	32.15	27.20	59.35	15.30	1.26	.33	1.48
16	12	7	9- 8-'10	3537	4.1	145.8	16.5	67.43	2365	3930	6	672	263	119	63	299	119	45	200	208	157	32.15	26.10	58.25	9.18	1.16	.41	1.65
17	12	4	7-25-'10	5670	3.9	217.6	16.0	105.37	2475	3630	5	627	263	119	63	281	104	36	200	206	248	31.35	25.65	57.00	48.37	1.85	.26	1.00

RECORD OF HERD J.—(Continued).

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Months.	Suerene.	Middlings.	Cottonseed.	Bran.	Corn.	Barley.	Oats.	Alfalfa Meal.	Gluten.	Dis. Grains.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
18	12	3	4-18-'10	1900	5.0	94.4	16.1	$35.59	2475	3630	5	672	263	119	63	282	112	41	200	222	243	$31.35	$26.30	$57.65	$-22.06	$ .63	.61	3.03
19	12	11	1-28-'10	1827	4.3	78.8	15.5	30.89	2345	3300	5	463	180	36	83	----	----	----	----	161	303	30.05	15.20	45.25	-14.36	.67	.57	2.48
20	12	7	4- 1-'10	6520	4.2	272.1	15.7	119.53	2365	3930	6	692	263	119	63	278	111	40	200	218	183	32.15	26.30	58.45	61.08	2.06	.21	.90
21	12	10	2-13-'10	3683	4.0	149.4	15.4	66.00	2365	3930	6	674	118	73	59	162	45	38	----	173	524	30.85	23.05	53.90	12.10	1.23	.36	1.46
22	12	11	5- 2-'10	5779	3.9	199.9	16.5	98.99	2365	3930	6	614	263	119	63	303	121	46	200	260	227	32.15	28.45	60.60	38.39	1.63	.30	1.18
23	12	6	3-13-'10	6045	2.9	177.7	16.0	112.27	2235	3600	6	709	343	55	111	152	64	38	100	229	290	32.15	23.65	55.80	56.47	2.01	.31	.92
24	12	2	5- 3-'10	4168	5.0	210.6	16.2	78.41	2365	3930	6	743	263	119	63	307	123	47	200	277	230	32.15	28.80	60.95	17.46	1.29	.29	1.46
25	12	7	5-10-'10	6254	4.1	255.4	15.8	115.06	2365	3930	6	748	263	119	63	311	126	48	200	274	255	32.15	29.20	61.35	53.71	1.88	.24	.99
26	12	7	7- 9-'10	3946	4.0	159.2	16.6	76.31	2365	3930	6	270	374	119	63	299	119	45	200	229	208	32.15	27.10	59.25	17.06	1.29	.37	1.50
27	5	--	----------	570	4.7	26.9	17.4	11.53	1020	2400	2	749	148	63	32	120	45	15	100	----	---	14.65	8.15	22.80	-11.27	.50	.84	4.10
28	12	9	8-19-'10	6370	4.5	294.3	16.5	121.97	2365	3930	6	702	263	119	63	312	124	49	200	285	212	32.15	29.15	61.30	60.67	1.99	.21	.96
29	12	2	3- 9-'10	5376	4.9	258.2	16.0	98.57	2365	3930	6	641	283	78	75	259	103	36	100	298	263	32.15	26.55	58.70	39.87	1.69	.23	1.71
30	12	14	11- 7-'10	5300	4.4	181.5	16.6	79.86	2365	3930	5	714	228	112	39	307	123	47	200	277	236	32.15	26.80	58.95	20.91	1.35	.32	1.43
31	12	11	9-14-'10	4127	5.0	281.6	16.8	109.86	2365	3630	5	734	245	115	63	292	79	49	200	285	242	32.65	28.35	60.40	49.46	1.83	.21	1.08
32	12	6	11- 5-'10	5603	5.3	195.1	16.6	71.86	2365	3930	6	----	263	119	63	303	121	46	200	260	227	32.15	28.45	60.60	11.26	1.19	.31	1.64
33	12	9	12- 9-'10	7378	4.3	316.4	16.5	141.97	2265	3930	6	----	494	127	----	636	161	115	246	275	235	32.15	30.55	62.70	79.27	2.36	.20	.85
34	12	4	11- 4-'10	4899	4.8	232.6	16.5	94.37	2265	3930	6	----	405	----	----	455	153	112	200	285	242	32.15	29.15	61.30	33.07	1.54	.26	1.25

RECORD OF HERD J.—(Continued.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Months.	Middlings.	Corn.	Barley.	Oats.	Sucrene.	Alfalfa.	Cottonseed.	Dis. Grains.	Gluten.		Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
35	12	8	12- 9-'10	6392	3.5	221.6	16.5	$123.01	2265	3930	6	405	607	157	113	333	200	90	263	298	---	$32.15	$29.85	$62.00	$61.01	$1.98	.28	.97
36	12	4	11- 1-'10	5016	5.0	251.0	16.4	95.28	2365	3930	6	405	439	150	112	451	200	90	251	281	---	32.15	29.45	61.60	33.68	1.54	.25	1.23
37	12	4	12-22-'10	4576	3.6	163.2	16.6	88.43	2285	3930	6	----	387	121	139	485	200	90	272	305	---	31.60	29.20	80.80	27.63	1.45	.37	1.33
38	4	2	5- 7-'11	1605	5.0	80.3	14.7	27.24	200	------	4	----	----	----	----	145	----	----	112	145	---	7.50	4.70	12.20	15.04	2.23	.15	.76
Totals for Testing Period			34.75	161459	4.3	6972.4	16.3	$3053.51	83000	136860	203	9839	10738	4185	1859	21891	7337	3862	7541	8512	---	$1111.10	$947.00	$2058.10	$995.41	$1.48	.29	1.27
Est. av. per Cow for 12 Months				4646	4.3	200.7	16.3	$87.87	2388	3938	5.8	283	309	124	53	630	211	107	217	245	---	$31.97	$27.25	$59.22	$28.65	$1.48	.29	1.27

Cow in Herd J. Record for one year, milk 7179.0 lbs., butter fat 297.8 lbs.

Cow in Herd J. Record for one year, milk 2808. lbs., butter fat 151.7 lbs. Loss $2.47.

Cow in Herd J. Record for one year, milk 7378.0 lbs., butter fat 316.4 lbs.

RECORD OF HERD K.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Stover.	Pasture.	Hom. Chop.	Sucrene.	Middlings.	Gluten.	Corn.	C. S. M.	Dis. Grains.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
------------------------	9	17	8-20-'10	4517	4.0	181.3	16.7	$87.44	1112	2900	2	120	1137	136	545	322	180	----	$12.89	$28.92	$41.81	$45.63	$2.09	.23	.92
------------------------	12	6	7-20-'10	4988	4.9	230.1	16.0	93.17	1120	2900	5	120	1176	177	584	227	180	30	16.94	30.92	47.86	45.31	1.95	.21	.98
------------------------	12	8	5-15-'10	5412	4.7	261.7	15.8	99.71	1120	2900	5	120	1176	177	584	227	180	30	16.94	30.92	47.86	51.85	2.06	.18	.86
------------------------	12	7	4- -'10	5821	4.8	277.5	16.1	109.16	1120	2775	5	120	1146	213	869	204	30	30	17.44	34.02	57.46	57.70	2.13	.19	.88
------------------------	12	8	2- -'10	5468	4.5	241.6	16.2	102.86	1120	2490	5	100	1151	181	534	288	200	30	17.04	32.11	49.15	53.71	2.09	.20	.90
------------------------	12	2	4- -'10	2805	4.5	126.5	16.1	52.45	1120	2850	5	100	942	145	649	69	60	30	16.99	25.91	42.90	9.55	1.22	.34	1.33
------------------------	12	7	7-24-'10	5286	5.3	282.3	16.2	99.58	1120	2900	5	120	1268	173	699	307	180	30	16.94	33.87	50.81	48.77	1.96	.18	.96
------------------------	12	4	4-15-'10	4938	4.4	215.1	15.8	90.97	1120	2900	5	120	1222	121	611	228	180	30	16.94	30.47	47.41	43.56	1.93	.22	.96
------------------------	12	15	8-15-'10	4759	4.0	185.7	16.1	88.95	1120	2900	5	120	956	137	669	260	180	30	16.94	31.02	47.96	40.99	1.82	.26	1.01
------------------------	6	9	3- -'10	1362	4.9	66.1	16.9	26.77	120	2150	2	30	630	15	270	200	180	----	4.79	16.79	21.58	5.19	1.24	.33	1.59
------------------------	7	--	----------	3847	4.9	187.1	16.2	72.15	1000	1700	3	-----	808	243	-----	569	232	30	13.65	22.00	35.65	36.50	2.03	.19	.92
------------------------	12	9	8- -'10 aborted.	5906	4.5	268.0	16.3	111.56	1120	2900	5	120	1268	173	699	307	180	30	16.94	33.87	50.81	60.75	2.19	.19	.86
------------------------	12	4	8- -'10	4019	5.4	217.3	16.0	74.91	1120	2900	5	120	956	137	634	270	180	30	16.94	30.92	47.86	27.05	1.57	.23	1.19
------------------------	12	12	2- -'10	4850	4.0	197.0	16.2	91.26	1120	2490	5	30	1173	158	614	402	200	30	16.99	31.14	48.13	43.13	1.90	.24	.99
------------------------	12	16	3- -'10	4641	4.9	229.1	16.3	87.64	1120	2665	5	80	1136	71	659	316	135	30	16.94	29.96	46.90	40.74	1.87	.20	1.01
------------------------	12	3	4- -'10	3525	5.8	205.3	16.0	65.72	1120	2900	5	110	905	150	654	204	90	30	16.94	27.30	44.24	21.48	1.49	.22	1.26
------------------------	7	3	----------	1669	5.5	92.4	16.7	32.47	420	3175	2	110	666	25	525	100	-----	----	7.74	19.70	27.44	5.03	1.18	.30	1.65

RECORD OF HERD K.—(Continued.)

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Punds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Hom. Chop.	Sucrene.	Middlings.	Gluten.	Corn.	C. S. M.	Dis. Grains.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
18	12	4	3- -'10	3365	4.9	164.3	16.5	$64.42	1120	3030	5	80	1123	153	614	232	325	30	$16.99	$30.21	$47.20	$17.22	$1.37	.29	1.40
19	12	4	5- -'10	4350	4.8	209.4	15.9	80.69	1120	3100	5	110	1202	186	709	148	90	30	17.24	30.25	49.49	33.20	1.71	.23	1.09
20	11	2	9-29-'10	4200	4.5	189.7	16.4	79.79	1000	3010	4	75	1211	125	721	409	180	30	16.10	32.30	48.40	31.39	1.65	.26	1.15
21	12	8	10-10-'10	5065	3.0	149.7	16.5	97.25	1120	2700	5	50	1009	150	725	409	180	30	17.55	36.55	54.10	43.15	1.80	.36	1.07
22	12	7	11- 6-'10	4500	5.7	255.2	16.6	86.92	1120	2900	5	110	1318	253	609	337	180	30	17.85	37.40	55.25	31.67	1.58	.22	1.23
23	12	10	11- 9-'10	5944	4.3	225.6	16.6	114.82	1120	2900	5	110	1356	276	605	366	180	30	16.85	35.30	52.15	62.67	2.15	.23	.88
24	3	9	11-24-'10	1747	4.5	77.8	17.0	34.58	120	2250	2	110	705	25	315	200	180	----	4.80	18.93	23.76	10.82	1.50	.31	1.36
25	12	5	12-21-'10	5945	3.4	204.1	16.5	113.41	1120	2900	5	-----	1126	177	669	405	435	30	16.85	33.25	50.10	63.31	2.27	.25	.84
Totals for Testing Period			22.5	108929	4.5	4939.9	16.3	$2058.65	25072	70085	110	2285	26856	3782	17466	7006	4182	630	$384.22	$744.00	$1128.28	$930.37	$1.82	.23	1.04
Est. av. per Cow for 12 Months				4841	4.5	219.6	16.3	$91.49	1114	3115	5	102	1193	168	776	311	186	28	$17.08	$33.07	$50.15	$41.34	$1.82	.23	1.04

RECORD OF HERD L.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Sucrene.	Corn.	Gluten.	Dis. Grains.	Beet Pulp.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	12	12	2-16-'11	2885	4.4	125.7	16.0	$53.56	860	1760	6	135	437	46	357	60	$19.70	$7.48	$27.18	$26.38	$2.04	.21	.91
2	9	10	2-15-'11	2314	4.6	105.6	16.7	44.94	1320	2610	3	165	340	70	200	90	16.20	8.03	24.23	20.71	1.86	.23	1.05
3	9	6	3-17-'11	1703	5.2	88.7	16.3	32.34	620	2390	3	75	337	38	207	-----	15.90	4.78	20.68	11.66	1.56	.23	1.22
4	9	12	1-18-'11	2395	5.2	124.5	16.9	47.10	1350	2550	3	165	533	104	293	90	16.75	10.93	27.68	19.42	1.70	.22	1.15
5	12	3	4- -'10	2548	5.7	145.7	16.3	48.39	1320	2610	6	120	453	69	258	45	20.90	7.53	28.43	19.93	1.70	.20	1.11
6	9	3	4- -'10	1061	5.5	58.3	17.4	21.49	1320	2610	3	90	403	59	208	45	16.40	6.33	22.73	–1.24	.94	.39	2.14
7	12	3	4- -'10	2550	4.9	125.4	15.3	45.57	1320	2610	6	45	358	56	208	-----	20.80	4.83	25.63	19.94	1.78	.20	1.00
8	12	3	4- -'10	1921	5.4	104.7	15.7	35.20	1320	2610	5	45	358	44	208	-----	20.80	4.83	25.63	9.58	1.38	.24	1.33
9	12	3	3- -'10	3953	3.6	142.8	15.7	72.37	1320	2610	6	90	468	64	318	-----	20.80	7.20	28.00	44.37	2.60	.20	.70
10	8	3	3- -'10	1062	4.8	50.7	17.3	21.36	1320	2610	2	90	358	44	208	-----	14.80	5.40	20.20	1.16	1.15	.40	1.91
11	9	10	8- -'10	2718	4.6	124.0	17.1	54.08	1320	2610	3	135	513	79	308	45	16.40	8.70	25.10	28.98	2.15	.20	.92
12	9	12	9-19-'10	3131	4.7	145.4	17.3	62.83	1320	2610	2	240	658	111	408	90	16.25	12.61	28.86	33.97	2.11	.20	.92
13	9	12	10-11-'10	3594	4.4	158.2	17.5	73.34	1320	2610	4	210	658	129	418	90	16.40	12.20	28.60	44.74	2.56	.18	1.10
14	12	10	12- 8-'10	4098	4.0	161.6	16.7	79.93	1050	2610	6	120	458	134	318	90	20.90	11.60	32.50	47.43	2.46	.21	.80
15	12	15	12- 8-'10	3330	3.6	119.9	16.7	64.71	1050	1350	6	120	408	114	418	90	20 90	11.60	32.50	32.21	1.98	.27	.91
16	4	2	1- 3-'11	1288	4.9	62.9	16.7	24.91	410	1790	1	120	248	88	158	90	7.00	6.20	13.20	11.71	1.67	.21	1.02
Totals for Testing Period			13.25	40551	4.5	1844.1	16.6	$782.12	18540	38550	65	1965	6988	1232	4500	825	$280.90	$130.25	$411.15	$370.97	$1.91	.22	1.01
Est. av. per Cow for 12 Months				306.1	4.5	139.2	16.6	$59.03	1400	2910	5	148	528	93	340	62	$21.20	$9.83	$31.03	$28.00	$1.91	.22	1.01

RECORD OF HERD M.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Butter Fat, Cents.	Value of Butter Fat.	Pounds of Feed Consumed.									Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1.00 Expended.	Cost to Produce 1 lb. Butter Fat.	Cost to Produce 100 lbs. Milk.
									Hay.	Stover.	Pasture—Months.	Bran.	Sucrene.	Corn.	Gluten.	Dis. Grains.	C. S. Meal.							
1	12			5229	3.9	204.8	38.7	$79.30	780	4500	6	585	709	436	258	46	92	$17.35	$26.05	$43.40	$35.90	$1.87	.21	.83
2	12			2899	6.0	175.2	39.3	68.89	780	4500	6	575	747		266	62	92	17.35	26.55	43.90	24.99	1.57	.25	1.51
3	12			3680	6.0	220.8	39.3	86.31	780	4500	6	575	771	543	300	79	92	16.10	27.60	43.70	42.61	1.98	.20	1.19
4	12			5324	4.3	231.1	40.5	93.45	630	4500	6	750	743	900	507	97	92	17.75	35.15	52.90	40.55	1.77	.23	.99
5	12			4953	4.8	237.1	39.7	94.15	780	4500	6	655	845	700	382	124	92	17.35	31.60	48.95	45.20	1.92	.21	.98
6	12			4701	5.3	250.4	40.7	101.89	630	4500	5	715	759	795	507	124	92	17.75	33.75	57.50	50.39	1.99	.21	1.07
7	12			5348	4.6	249.1	39.0	97.36	780	4500	6	625	820	502	249	39	92	17.35	25.35	42.70	54.66	2.29	.17	17.80
8	12			4500	4.5	201.9	38.0	76.55	780	4500	6	575	786	558	315	88	92	16.35	28.05	44.40	32.15	1.72	.22	.99
9	12			2604	5.5	144.9	39.6	57.41	730	4500	6	467	737	401	298	56	92	17.80	23.50	41.30	16.11	1.39	.29	1.09
10	12			3944	5.4	214.6	41.2	84.48	780	4500	6	475	594	356	266	56	92	17.35	23.73	41.08	43.40	2.06	.19	1.04
11	12			2762	4.8	134.5	39.0	52.48	780	4500	6	435	659	381	248	46	92	17.35	22.18	39.53	12.95	1.33	.29	1.43
12	12			5777	4.1	235.6	40.6	95.50	780	4500	6	750	788	825	607	124	92	17.35	35.43	52.78	42.77	1.81	.22	.91
13	12			3343	5.8	194.1	39.4	76.69	780	4500	6	465	644	396	261	62	92	17.35	22.63	39.98	36.71	1.94	.21	1.19
14	8			1016	3.9	49.3	42.8	21.17	780	4500	2	380	306	326	221	62	92	13.35	14.78	28.13	-6.96	.75	.57	2.76
15	12			3503	5.4	197.1	38.3	75.50	780	4500	6	405	672	424	251	56	92	17.35	23.23	40.58	34.92	1.86	.21	1.16
16	12	7		2294	4.3	97.5	39.3	38.35	780	4500	6	380	1458	298	193	46	45	17.35	16.68	34.03	4.32	1.13	.35	1.48
17	12	3		3231	5.3	171.0	39.5	67.17	780	4500	6	465	672	424	251	56	92	17.35	23.23	23.40	26.59	1.66	.24	1.28

RECORD OF HERD M—(Continued).

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Butter Fat, Cents.	Value of Butter Fat.	Pounds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Bran.	Suerene.	Corn.	Gluten.	Dis. Grains.	C. S. Meal.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1.00 Expended.	Cost to Produce 1 lb. Butter Fat.	Cost to Produce 100 lbs. Milk.
18	12	4	5- -'10	2808	5.4	152.1	38.8	$59.05	780	4500	6	545	677	409	266	56	92	$17.35	$25.23	$42.58	$16.47	$1.39	.28	1.52
19	12	3	6- -'10	2221	5.4	120.1	39.6	47.52	780	4500	6	470	634	391	251	56	92	17.35	22.53	39.88	7.64	1.19	.33	1.79
20	12	3	6- -'10	2853	5.9	167.8	39.3	65.46	780	4500	6	365	653	405	233	46	92	17.35	22.53	39.88	25.58	1.64	.24	1.40
21	10	3	11-10-'10	3195	5.0	159.0	39.6	63.17	630	4500	4	340	452	454	281	56	92	15.10	19.80	34.90	28.27	1.81	.22	1.09
22	9	3	12- 6-'10	2822	4.7	133.1	39.3	52.38	630	4500	4	277	321	689	114	141	92	14.15	18.55	32.70	19.68	1.65	.25	1.16
23	5	3	3-30-'11	2842	4.4	125.5	36.4	45.44	420	840	4	255	380	282	55	-----	92	7.50	12.50	20.00	25.44	2.27	.16	.91
Totals for Testing Period			21.67	81849	5.0	4066.6	39.3	$1599.65	16930	99840	128	11589	14827	11414	6580	1527	2054	$386.50	$561.98	$948.48	$651.17	$1.69	.23	1.16
Est. av. per Cow for 12 Months				3777	5.0	187.6	39.3	73.82	781	4607	6	535	686	527	304	70	95	$17.84	$25.93	$43.77	$30.05	$1.69	.23	1.16

RECORD OF HERD N.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Months.	Surene.	Corn.	Gluten.	Stover.	Oats.	Dis. Grains.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1.00 Expended.	Cost to Produce 1 lb. Butter Fat.	Cost to Produce 100 lbs. Milk.
1	12	3	2-25-'10	4015	4.7	188.9	15.7	$73.60	1250	4000	6	420	322	306	850	53	360	$23.80	$14.20	$38.00	$35.60	$1.94	.20	.94
2	12	8	9- 6-'10	3694	5.1	189.9	16.9	72.75	1250	4500	6	386	251	323	1000	53	412	23.80	15.70	39.50	33.25	1.84	.21	1.07
3	12	--	8- -'09	3785	4.1	153.7	16.5	72.25	1250	4500	6	386	329	325	1000	53	393	23.80	15.40	39.20	33.05	1.85	.25	1.04
4	12	8	4-10-'10	4814	4.4	213.1	16.2	90.26	1250	4500	6	386	342	338	1000	53	422	23.80	15.90	39.70	50.56	2.26	.18	.82
5	12	4	12-26-'11	4037	4.1	163.8	16.5	77.67	1100	4500	6	336	416	294	1000	165	294	23.15	17.25	40.40	37.27	1.92	.24	1.00
6	12	4	4- 3-'10	4572	4.7	217.3	15.5	82.29	1250	4700	6	326	248	304	1000	53	313	23.50	13.90	37.40	44.89	2.20	.17	.82
7	12	10	9- 5-'10	3759	4.7	174.7	17.4	76.14	1250	4500	6	330	399	274	1000	80	294	23.80	13.95	37.75	38.39	2.02	.21	1.01
8	12	7	12-20-'09	5438	4.5	246.7	16.2	102.30	1330	4800	6	266	161	304	1000	115	460	24.25	15.65	39.90	62.40	2.60	.16	.73
9	12	7	9- 2-'10	5536	5.3	293.1	16.6	106.68	1250	4500	6	360	422	391	1000	80	418	23.80	17.50	41.30	65.38	2.57	.14	.75
10	12	10	5-20-'10	4846	4.8	235.6	16.6	93.36	1250	4500	6	370	318	312	1000	53	422	23.80	15.90	39.70	53.66	2.36	.17	.82
11	12	6	2- 9-'10	5294	4.5	204.6	16.1	99.08	1250	4500	6	386	314	310	1000	53	398	23.80	15.20	39.00	60.08	2.54	.16	.74
12	12	3	6-13-'10	5040	4.6	233.6	15.9	93.43	1250	4500	6	386	312	308	1000	53	375	23.80	14.80	38.60	54.83	2.42	.16	.77
13	12	5	2- 2-'10	4106	4.8	195.4	16.7	79.82	1250	4500	6	210	291	270	1000	120	460	23.85	14.85	38.70	41.12	2.07	.20	.94
14	12	2	4- -'10	3828	5.1	195.2	15.9	70.90	1250	4500	6	326	323	319	1000	53	420	23.80	14.50	38.30	32.60	1.85	.20	1.01
15	12	10	9- 8-'10	4646	4.3	200.7	16.9	91.64	1250	4500	6	386	427	350	1000	80	407	23.80	16.65	40.45	51.19	2.26	.20	.88
16	12	10	9- 9-'10	4094	4.2	174.2	16.8	80.38	1250	4500	6	386	436	389	1000	80	410	23.80	17.70	41.50	38.80	1.94	.24	1.02
17	12	10	6- -'10	5715	5.4	313.6	16.0	106.74	1250	4500	6	386	269	325	1000	105	346	23.80	15.40	39.20	67.54	2.73	.13	.69

RECORD OF HERD N—(Continued).

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Months.	Sucrene.	Corn.	Gluten.	Stover.	Oats.	Dis. Grains.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1.00 Expended.	Cost to Produce 1 lb. Butter Fat.	Cost to Produce 100 lbs. Milk.
18	12	10	4- 9-'10	3957	4.2	166.5	15.5	$71.63	1250	4500	6	265	271	244	1000	70	415	$22.55	$13.15	$35.70	$35.93	$2.02	.21	.91
19	12	4	9-10-'10	4690	5.3	247.5	16.8	92.09	1250	4500	6	386	404	377	1000	80	413	23.80	16.80	40.60	51.49	2.25	.16	89
20	12	10	9- 6-'10	3634	4.1	140.0	16.6	70.34	1250	4500	6	326	324	327	1000	53	388	23.80	14.40	38.20	32.14	1.85	.27	1.05
21	12	7	8-22-'10	4774	4.7	222.8	17.1	94.88	1250	4500	6	386	404	367	1000	157	336	23.80	16.80	40.60	54.28	2.34	.18	.85
22	12	3	3- 7-'10	4667	4.8	225.2	15.8	85.58	1250	4500	6	326	342	258	1000	103	420	23.90	15.10	39.00	46.58	2.19	.17	.84
23	12	10	5-26-'10	3885	5.1	197.1	16.0	72.10	1250	4500	6	386	293	288	1000	53	325	23.80	14.10	37.90	34.20	1.90	.19	.98
24	12	7	4- 7-'10	4587	5.0	229.3	16.2	86.35	1250	4500	6	386	342	368	1000	53	422	23.80	15.10	38.90	47.45	2.22	.17	.85
25	2	--	----------	528	6.3	33.5	16.4	10.02	100	------	2	210	90	-----	-----	-----	-----	3.20	3.00	6.20	3.82	1.60	.18	.47
26	12	5	9- 2-'10	4856	4.8	232.3	16.5	92.97	1250	4500	6	330	389	274	1000	80	314	23.80	15.05	38.85	54.12	2.40	.17	.80
27	12	3	2- 2-'10	4109	5.0	205.9	16.5	78.88	1250	4500	6	326	386	349	1000	80	460	23.80	16.50	40.30	38.58	1.97	.20	.98
28	12	6	3-10-'10	2889	4.5	131.0	15.4	51.76	1250	4500	6	266	231	244	1000	40	370	23.85	11.65	35.50	16.26	1.46	.27	1.23
29	12	2	11- 1-'10	3655	5.7	207.5	15.9	67.42	1250	4500	6	386	202	205	1000	113	288	23.80	13.50	37.30	30.12	1.80	.18	1.02
30	12	2	3-15-'10	3433	5.9	201.0	16.5	65.40	1250	4500	6	386	342	338	1000	53	422	23.80	15.10	38.90	26.50	1.68	.19	1.13
31	12	7	10-20-'10	5632	4.5	252.8	17.0	111.55	1250	4500	6	386	431	394	1000	80	460	23.80	17.90	41.70	69.85	2.68	.17	.74
32	12	7	10-21-'10	5397	4.8	252.7	16.7	105.57	1150	4500	6	316	361	304	1000	170	460	22.60	16.90	39.50	66.07	2.67	.16	.75
33	12	10	11- 3-'10	5071	4.6	233.4	17.4	102.34	1150	4500	6	346	391	-----	580	471	460	23.10	17.40	40.50	61.84	2.53	.17	.80
34	12	10	11- 1-'10	5654	3.0	170.4	17.3	113.70	1150	4500	6	336	281	344	1000	230	460	23.10	17.40	40.50	73.20	2.81	.24	.72

RECORD OF HERD N.— (Continued).

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Per Gal., Cents.	Value of Milk.	Pounds of Feed Consumed. Hay.	Silage.	Pasture—Months.	Sucrene.	Corn.	Gluten.	Stover.	Oats.	Dis. Grains.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1.00 Expended.	Cost to Produce 1 lb. Butter Fat.	Cost to Produce 100 lbs. Milk.
35	4	6	5- 1-'11	2086	4.3	89.9	14.7	$35.64	75	------	4	56	22	176	150	-----	235	$4.85	$5.25	$10.10	$25.54	$3.53	.11	.50
36	4	2	5-10-'11	1871	4.6	885.5	14.6	31.65	------	------	4	-----	-----	-----	56	153	190	4.10	4.40	8.50	23.15	3.72	.10	.45
37	1	2	11- 1-'11	472	4.0	18.9	18.0	9.91	330	1600	-----	150	130	115	-----	-----	-----	4.40	2.40	6.80	3.11	1.46	.35	1.47
38	3	2	6-11-'11	819	5.0	40.4	14.4	13.72	------	------	3	-----	-----	-----	56	113	110	3.10	3.20	6.30	7.42	2.18	.16	.77
Totals for Testing Period			34.17	153907	4.7	7177.7	16.4	$2932.79	42535	150100	211	32730	11306	3303	11949	10562	13554	$800.90	$529.55	$1330.45	$1602.34	$2.21	.18	.86
Est. av. per Cow for 12 Months				4504	4.7	210.1	16.4	85.83	1245	4393	6	958	331	97	350	309	397	$23.43	$15.50	$38.93	$46.90	$2.21	.18	.86

RECORD OF HERD O.

No. of Cow.	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Butter Fat, Cents.	Value of Butter Fat.	Pounds of Feed Consumed. Hay.	Stover.	Pasture—Months.	Bran.	Corn Chop.	Dis. Grains.	Cotton Seed.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
1	9		5- -'10	4053	4.7	191.6	36	$69.01	830	2430	4	810	650	90	25	$12.34	$16.46	$28.80	$40.21	$2.40	.15	.71
2	12		12- 1-'10	4704	5.7	268.4	34	92.08	830	2330	6	793	885	269	85	16.84	20.46	37.30	54.78	2.47	.14	.80
3	12			6124	4.0	243.2	37	88.62	830	2150	6	793	915	239	85	16.84	20.16	37.00	51.62	2.40	.15	.60
4	12		12-10-'10	4691	4.3	202.2	32	64.90	830	2390	6	927	713	153	30	16.84	18.96	35.80	29.10	1.81	.17	.76
5	12		10-12-'10	4934	4.9	242.4	36	86.97	830	2390	6	763	885	239	85	16.84	19.86	36.70	50.27	2.37	.15	.75
6	2		10-12-'10	591	4.5	26.4	37	9.58	220	360	1	165	180			2.67	3.43	6.10	3.48	1.57	.23	1.04
7	11		10-12-'10	3907	4.1	159.7	35	55.84	710	2390	5	715	820	217	55	15.37	17.73	33.10	22.78	1.68	.21	.85
8	11		10-12-'10	4026	4.9	198.6	36	71.74	710	2390	5	738	865	239	85	15.37	19.03	34.40	37.34	2.09	.17	.86
9	11			4070	5 0	206.9	36	75.02	710	2390	5	738	865	239	85	15.37	19.03	34.40	40.60	2.18	.16	.84
10	1		3-12-'11	660	4.4	29.0	41	11.89	110	500		130				1.40	1.60	3.00	8.89	3.96	.10	.45
Totals for Testing Period			7.75	37760	4.7	1768.4	35.4	$625.65	6610	20020	43	6572	6778	1685	535	$129.88	$156.72	$286.60	$339.05	$2.18	.16	.76
Est. av. per Cow for 12 Months				4872	4.7	228.2	35.4	$80.73	853	2583	5.5	848	875	217	69	$16.76	$20.24	$37.00	$43.75	$2.18	.16	.76

GENERAL SUMMARY OF THE RECORDS OF THE FIRST MARYLAND COW-TESTING ASSOCIATION, 1910-1911.

Herd Letter.	No. of Cows.	Pounds of Milk.	Average Test.	Pounds of Fat.	Value of Milk.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Profit.	Returns for $1 in Feed.	Cost of 100 lbs. Milk.
B	6	38596	4.7	1815.7	$656.43	$146.06	$116.30	$262.36	$394.07	$2.50	$0.68
C	23.08	105653	4.2	4496.6	1824.96	537.91	491.90	1029.81	795.15	1.77	.98
D	28.5	110265	4.3	4715.1	1881.40	719.40	491.12	1210.52	670.98	1.55	1.10
E	11.75	59368	5.0	2975.3	1150.06	265.22	304.04	569.26	580.80	2.02	.96
F	14.75	67584	4.4	2954.1	1315.97	247.47	336.70	584.17	731.80	2.25	.87
G	20.	98884	4.8	4793.6	1878.04	478.72	580.32	1059.04	819.00	1.77	1.07
H	17.5	84664	4.3	3660.2	1593.24	359.20	455.47	814.67	778.57	1.95	.96
I	10.0	35356	5.0	1780.3	656.66	297.22	146.53	443.75	212.91	1.48	1.25
J	34.75	161459	4.3	6972.4	3053.51	1111.10	947.00	2058.10	995.41	1.48	1.27
K	22.5	108929	4.5	4939.9	2058.65	384.22	744.06	1128.28	930.37	1.82	1.04
L	13.25	40551	4.5	1844.1	782.12	280.90	130.25	411.15	370.97	1.91	1.01
M	21.67	81849	5.0	4066.6	1599.65	386.50	561.98	948.48	651.17	1.69	1.16
N	34.17	153907	4.7	7177.7	2932.79	800.90	529.55	1330.45	1602.34	2.21	.86
O	7.75	37760	4.7	1768.4	625.65	129.88	156.72	286.60	339.05	2.18	.76
Total	256.76	1184375	4.55	53903.8	22009.13	$6144.71	$5992.94	$12137.65	$9871.84	$1.81	$1.02
Average	19.	4456	-------	202.1	82.81	$23.12	$22.55	$45.67	$37.14	$1.81	$1.02

HERD RECORD OF JAMES W. BEACHAM, FROM JUNE 30, 1910, TO JULY 1, 1911.

No. of Cow.	Testing Period. From	Testing Period. To	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Cents, Gal.	Value of Milk.	Pounds of Feed Consumed. Alfalfa.	Bran.	Silage.	Stover.	Clover.	Grain Mixture.	Corn.	Pasture.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
																		Days.							
1 --	6-30-'10	1- 1-'11	6	--	----------	713.5	4.7	33.6	13.1	10.83	1289	244	3375	------	------	-----	-----	92	$20.65	$3.18	$23.83	Loss. $13.00	$ .45	70.9	3.34
2 --	6-30-'10	1- 1-'11	6	--	----------	890.9	6.0	53.3	15.9	16.43	1289	244	3375	------	------	-----	-----	92	20.65	3.18	23.83	Loss. 7.40	.69	44.7	2.67
3 --	6-30-'10	7- 1-'11	12	8	1-26-'11	4020.3	4.4	177.8	14.1	66.20	1645	356	7508	1200	488	70[illegible]	------	153	39.21	13.29	52.50	Profit. 13.70	1.26	29.5	1.30
4 --	6-30-'10	1- 1-'11	6	--	----------	2199.7	4.2	91.2	13.6	34.84	1289	279	3070	300	------	------	65	92	20.64	4.18	24.82	Profit. 10.02	1.40	27.2	1.13
5 --	6-30-'10	7- 1-'11	12	6	10-11-'10	2740 3	4.5	123.7	15.6	49.74	1586	124	7720	1359	248	78[illegible]	------	153	35.47	11.24	46.71	Profit. 3.03	1.06	37.7	1.70
6 --	6-30-'10	5- 1-'11	10	--	4- 6-'11	2013.9	4.4	81.4	12.2	28.76	1919	244	7125	892	------	9[illegible]	------	92	33.26	4.29	37.55	Loss. 8.79	.76	46.1	1.86
7 --	6-30-'10	3- 1-'11	8	--	----------	4007.5	3.9	164.4	13.4	62.43	1676	244	4800	1049	------	459	------	92	27.88	8.82	36.70	Profit. 25.73	1.70	22.3	.91
8 --	6-30-'10	7- 1-'11	12	8	10-15-'10	4573.5	3.7	164.3	16.1	85.65	1493	174	7508	1537	------	1317	------	153	33.46	18.46	51.92	Profit. 33.73	1.65	31.6	1.12
9 --	6-30-'10	7- 1-'11	12	7	2-25-'11	5935.8	3.7	218.6	13.1	90.97	1950	356	7508	1413	------	639	------	153	37.40	12.51	49.91	Profit. 41.06	1.82	22.8	.84
10 --	6-30-'10	7- 1-'11	12	12	1-20-'11	6235.6	3.4	214.1	13.5	97.96	2011	356	7658	1410	------	957	------	153	38.14	16.41	54.55	Profit. 43.41	1.79	25.4	.87
11 --	6-30-'10	7- 1-'11	12	7	9-11-'10	3146.5	5.1	148.9	15.5	56.74	1676	356	7203	1667	488	501	------	153	39.71	10.75	50.46	Profit. 6.28	1.12	33.8	1.60
12 --	6-30-'10	1- 1-'11	6	--	----------	1319.0	3.3	44.2	10.4	1.593	1289	244	3375	------	------	------	------	92	20.65	3.18	23.83	Loss. 7.90	.68	53.9	1.81
13 --	6-30-'10	1- 1-'11	6	--	----------	697.9	4.7	32.7	13.3	10.81	1134	244	3220	------	------	------	------	92	19.02	3.18	22.20	Loss. 11.39	.49	67.8	3.18
14 --	6-30-'10	10- 1-'10	3	--	----------	773.6	3.8	29.5	10.0	8.94	458	136	------	------	------	------	------	92	8.12	1.78	9.90	Loss. .96	.90	33.5	1.28
15 --	6-30-'10	5- 1-'11	10	11	3- 1-'11	2851.3	4.0	114.9	14.3	47.37	1919	244	6830	954	------	399	------	92	32.92	8.08	41.00	Profit. 6.37	1.16	35.6	1.44
16 --	6-30-'10	7- 1-'11	12	10	9-10-'10	5819.0	3.7	224.4	15.7	106.53	1733	294	7508	1537	------	1166	------	153	35.62	18.17	53.79	Profit. 52.74	1.98	23.9	.92
17 --	8-31-'10	7- 1-'11	10	5	9- 1-'10 6- 2-'11	4575.5	3.9	178.2	16.0	85.15	1242	232	6768	1514	372	873	------	91	30.79	13.75	44.54	Profit. 40.61	1.91	24.9	.97

HERD RECORD OF JAMES W. BEACHAM, FROM JUNE 30, 1910, TO JULY 1, 1911.— (Continued.)

No. of Cow.	Testing Period. From	Testing Period. To	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Cents. Gal.	Value of Milk.	Pounds of Feed Consumed. Alfalfa.	Bran.	Silage.	Stover.	Clover.	Grain Mixture.	Corn.	Pasture.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
18 --	10-31-'10	7- 1-'11	8	6	11-25-'10	5397.2	4.7	252.5	15.0	$94.42	542	112	5145	1479	488	1349	------	Days. 61	$22.16	$18.04	$40.20	Profit. $54.22	$2.35	15.9	.75
19 --	11-30-'10	7- 1-'11	7	5	12- 1-'10	4097.1	4.3	176.7	15.2	72.39	542	112	5063	1479	488	1110	------	61	22.04	15.07	37.11	Profit. 35.28	1.95	20.9	.90
20 --	11-30-'10	7- 1-'11	7	7	12-21-'10	3234.5	4.2	135.6	14.9	56.05	542	112	5063	1479	488	841	------	61	22.04	11.80	33.84	Profit. 22.21	1.66	24.9	1.05
22 --	5-31-'10	7- 1-'11	1	--	6- 2-'11	246.6	4.5	11.1	13.0	3.72	------	50	533	------	------	------	------	30	1.80	.65	2.45	Profit. 1.27	1.52	22.0	.99
23 --	6-20-'10	7- 1-'11	⅓	--	6-21-'11	29.9	3.6	1.0	13.0	.45	------	50	533	------	------	------	------	30	1.80	.65	2.45	Loss. 2.00	.18	68.0	8.12
Totals for Testing Period------					14.75	65519.1	4.07	2672.1	14.4	$1102.31	27224	4807	110928	19269	3060	11186	65	2233	$563.43	$200.66	$764.09	$338.22	$1.44	.285	1.17
Est. av. per Cow for 12 Months-----------						4441.9	4.07	181.1	14.4	$74.73	1846	326	7520	1306	207	758	4	151	$38.20	$13.60	$51.80	$22.93	$1.44	285	1.17

HERD RECORD OF JAMES W. BEACHAM, FROM JULY 1, 1911, TO JULY 1, 1912.

No. of Cow.	Testing Period. From	Testing Period. To	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk, Cents, Gal.	Value of Milk.	Pounds of Feed Consumed. Alfalfa.	Bran.	Silage.	Grain Mixture.	Corn & Cob Mix.	C. S. M.	Pasture.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
3	6-30-'11	6-30-'12	12	9	11-11-'11	7980.5	4.52	360.96	17.5	$158.70	2430	319	9275	1252	674	44	Days. 210	$41.89	$26.62	$71.54	$91.04	$2.27	19.8	89.6
8	8-25-'11	9-24-'11	1	9	8-25-'11	637.3	4.00	26.92	15.	11.14	-----	217	1860	-----	-----	-----	90	5.78	2.82	8.60	2.90	1.33	31.9	13.5
9	6-30-'11	11-30-'11	5	8	2-25-'11	2996.9	3.73	112.04	15.4	53.16	610	217	3910	-----	88	44	150	18.47	4.45	22.92	30.24	2.31	20.4	76.4
10	6-30-'11	10-15-'11	3½	13	1-20-'11	1100.7	4.48	49.37	15.0	18.19	140	217	2280	-----	-----	-----	105	8.72	2.82	11.54	6.65	1.57	23.3	104.8
11	6-30-'11	6-30-'12	12	8	9- 6-'11	7002.8	4.46	312.85	16.7	137.60	2140	319	9205	980	514	44	210	45.09	22.14	67.23	70.37	2.04	21.4	96.
16	6-30-'11	9-30-'11	3	12	-----	-----	----	-----	----	-----	-----	124	930	-----	-----	-----	90	5.89	1.86	7.72	Loss. 7.72	Loss. 1.00	-----	-----
17	6-30-'11	10-14-'11	3½	6	6- 2-'11	2183.9	4.13	90.16	15.	37.15	130	217	2150	-----	-----	-----	115	9.77	3.23	11.94	25.21	3.11	13.2	54.
18	6-30-'11	9-30-'11	3	7	-----	859.8	4.70	40.46	14.3	13.61	-----	217	1860	-----	-----	-----	90	7.29	3.23	10.52	3.09	1.29	25.9	120.
19	10- 8-'11	6-30-'12	8⅔	7	10- 8-'11	9192.4	4.41	405.75	17.5	187.67	3180	226	8190	1818	168	44	210	53.02	28.02	81.04	106.63	2.31	19.9	88.
20	10- -'11	6-30-'12	9	8	-----	6565.8	4.21	276.64	17.5	134.12	2350	226	8035	817	561	44	180	40.01	19.62	59.63	74.49	2.25	21.5	90.
22	6-30-'11	6-30-'12	10½	--	6-21-'11	6934.6	4.57	347.68	16.7	129.51	2440	319	9235	727	278	44	210	43.84	17.12	60.96	68.55	2.12	17.5	87.
23	6-30-'11	6-30-'12	12	--	6-26-'11	809.63	3.83	310.12	16.7	151.94	2440	319	9235	777	520	44	210	43.84	20.13	63.97	97.97	2.53	20.6	79.
24	6-30-'11	3-15-'12	9½	--	7-15-'11	5553.8	3.83	213.17	16.6	103.96	2430	319	8955	657	88	44	210	43.42	13.39	56.81	47.15	1.82	26.6	102.
25	8- 7-'11	6- -'12	11	--	8- 7-'11	6286.7	3.73	235.00	17.	125.37	2440	195	8305	724	509	44	150	40.95	17.53	57.98	67.39	2.16	24.6	92.
26	8-17-'11	6-30-'12	11	--	-----	4655.2	4.64	216.22	17.	94.01	2440	195	8305	450	336	44	180	44.45	12.31	56.76	37.25	1.65	26.2	121.
27	8-16-'11	9-16-'11	1	--	-----	171.9	5.03	8.83	15.	3.05	-----	93	930	-----	-----	-----	60	3.39	1.39	4.78	Loss. 1.73	.64	54.2	1.77
28	9-20-'11	6-31-'12	9⅓	--	9-20-'11	3988.1	4.20	167.59	17.5	81.01	2520	105	7735	441	335	44	150	40.42	10.89	51.31	29.70	1.57	30.6	128.

HERD RECORD OF JAMES W. BEACHAM, FROM JULY 1, 1911, TO JULY 1, 1912.—(Continued).

No. of Cow.	Testing Period. From	Testing Period. To	Months in Test.	Age of Cow.	When Fresh.	Pounds Milk During Testing Period.	Average Test.	Pounds Butter Fat During Testing Period.	Average Price of Milk.	Value of Milk.	Pounds of Feed Consumed. Alfalfa.	Bran.	Silage.	Grain Mixture.	Corn & Cob Mix.	C. S. M.	Pasture.	Cost of Roughage.	Cost of Grain.	Total Cost of Feed.	Total Profit.	Returns for $1 Expended for Feed.	Feed Cost to Produce 1 lb. Butter Fat.	Feed Cost to Produce 100 lbs. Milk.
29	10- 1-'11	6-31-'12	8			4227.6	4.63	196.13	17.5	$95.30	2440		6755	650	455	44	60	$36.04	$12.93	$48.97	$46.33	$1.91	24.2	1.11
30	11- 1-'11	6-30-'12	8		11- 1-'12	4498.5	4.20	189.27	17.5	93.46	2220	105	6715	658	585	44	70	34.08	16.00	50.08	43.38	1.86	26.4	.89
31	10-27-'11	6-20-'12	8		11-25-'11	6291.4	3.81	249.69	17.5	125.38	2210	102	6685	876	720		60	34.32	18.90	53.22	72.76	2.35	21.3	.84
32	10-28-'11	6-30-'12	8		10-25-'11	5988.8	3.22	192.94	17.5	122.89	2160	102	6515	841	692		60	36.98	18.43	55.41	67.48	2.21	28.6	.92
33	11- 1-'11	6-30-'12	8		10-30-'11	5492.7	4.06	243.56	17.5	123.26	2330	102	6485	830	718		45	32.80	18.41	51.21	72.05	2.40	21.0	.85
34	11- 1-'11	6-30-'12	8		11- 1-'11	5494.3	4.05	222.97	15.3	113.30	2120	102	6405	836	635		75	34.05	17.39	51.44	61.86	2.20	23.	.93
35	12-20-'11	6-30-'12	6.3		12-20-'11	3095.3	4.75	147.22	17.7	77.49	1700	102	4935	462	630		30	24.65	13.15	37.80	39.64	2.04	25.6	1.22
37	12-15-'11	6-30-'12	6.5		12-15-'11	5366.5	4.16	223.51	17.7	112.00	1700	102	4935	769	809		30	24.85	18.51	43.36	68.64	2.58	19.4	.80
38	12-30-'11	6-30-'12	6		12-30-'11	3647.6	4.01	146.49	17.7	75.57	1550	102	4485	407	713		60	23.49	13.29	36.78	38.79	2.05	25.1	1.00
39	2- 1-'12	6-30-'12	5			1634.6	4.49	81.66	17.4	33.43	1210	102	2565	100	339		60	18.55	6.20	24.75	8.68	1.35	30.2	1.51
40	2- 1-'12	6-30-'12	5			1738.5	4.55	79.21	17.6	35.64	900	102	2535	101	293		60	14.06	5.15	19.21	16.43	1.85	24.2	1.10
41	3-25-'12	6-30-'12	3.2			2318.2	5.20	120.72	17.5	46.77	610	102	1520		499		60	9.64	6.52	16.16	30.61	2.89	13.3	.69
Totals for Testing Period						124501	4.23	5267.13	16.7	$2500.63	46840	5049	161230	15191	11112	572	3290	$822.75	$372.45	$195.20	$305.43			
Est. av. per Cow for 12 Months						7323	4.23	309.78	16.7	$147.05	2755	291	9489	893	653	33	153	$48.39	$21.90	$70.29	$76.79	$2.02	.243	1.06

Summary.

The most profitable cow in the association gave a net return of $92.46, while the poorest cow was kept at a loss of $22.06.

The best six cows in the association were kept at an average profit of $83.17; the six making the lowest production were kept at an average loss of $3.17.

In the most profitable herd one dollar expended for feed made a return of $2.50, while in the least profitable herd the same amount expended for feed made a return of $1.48.

One herd contained a cow that was the third most profitable in the association and two that were kept at a loss. This wide variation is characteristic of herds that have no records.

Tht total cost of feed consumed was $12,137.00. Of this amount, $5,521.00 worth was purchased. This means that nearly half the feed consumed was purchased. By the growing of leguminous crops on the farm this outlay for feed could be materially reduced.

Feeding Dairy Cattle and Home Grown Rations.

Next to having a cow that is capable of making a large annual yield, it is of the greatest importance that she be fed a ration that will furnish a sufficient amount of the different nutrients required for the maintenance of her body and the production of milk. This means that the proper proportion of protein, carbohydrates and fat be contained in the ration fed. Protein is the highest priced nutrient required by the dairy cow. Carbonhydrates and fat are found in the cheaper feeds, and the ones usually grown in abundance on all farms. The cheapest source of protein is the legumes; such as alfalfa, clover, vetch, cow-peas and soy beans. Corn and corn silage contain chiefly carbohydrates and fat. A legume hay, with corn silage and corn, furnish most of the ration required by a dairy cow. Small amounts of cotton seed meal and bran may be used to complete the ration.

The cow that is fed all she will eat without gaining in weight is the most economical producer. The feed consumed by the dairy cow is used for the maintenance of her own body and the production of milk. The needs of the body are supplied first. After this all that she will consume is used for production. If she is fed a little more than the body requires, she will make a low yield and the cost of production will be high. If fed all she will eat the yield will be large, and the cost of production low. In the average herd some of the cows receive more than they will use for milk production; and some do not receive as much as they are capable of using economically. Thus the low-producing cow is over fed, and the high-producing cow, under fed. One cow causes a loss by consuming more feed than she can use for production; the other fails to make her maximum production because she is underfed.

Home Grown Rations.

Another factor which tends to make the production of milk much higher than it should be, is the large amounts of high-priced concentrates that are purchased by the Maryland dairyman. This great expenditure could be reduced to a minimum by the growing of legumes for hay, and corn for silage. Alfalfa, corn silage and corn make nearly a balanced ration. It may be necessary to purchase small amounts of some protein concentrate to complete the ration for the large producing cows. The growing of alfalfa, clover and other legumes is the cheapest way in which to supply the protein needed on the farm, and at the same time increase the fertility of the land. Alfalfa, when once a stand is secured, lasts a number of years. By liming and inoculating the soil this valuable legume can be grown on nearly every dairy farm in Maryland, and will prove the chaepest source of high-priced protein feed.

The legumes not only furnish the most costly part of the ration, but are highly beneficial to the land. They increase the supply of nitrogen, and leave a large amount of organic matter in the soil.

When once the legumes are grown in abundance, and every dairyman has a silo for his corn, the profits yielded from the dairy cow will be increased to a surprising extent.

Balanced Rations.

As stated previously, the cheapest and best rations used as a base is corn silage and alfalfa, or one of the other legumes as the roughage. For the grain portion of the ration corn, with the addition of some protein concentrate, is satisfactory. Of the protein concentrates offered on the market, the ones furnishing the nutrients cheapest should be considered.

When mixed hay or corn fodder are available they may be worked into the ration. In addition some roots and dried beet pulp are frequently used for cows on test.

The following rations are calculated for a 1000-lb. cow, giving about 25 pounds of milk per day:

Ration 1.

Corn silage	30 lbs.
Clover hay	12 "
Corn	4 "
Bran	3 "

Ration 2.

Corn silage	30 lbs.
Alfalfa hay	10 "
Corn	5 "
Cottonseed meal	1 "

Ration 3.

Clover hay	20 lbs.
Corn	5 "
Bran	2 "

Ration 4.

Clover hay	20 lbs.
Corn and cob meal	6 "
Cottonseed meal	2 "

RATION 5.

Clover hay	12	lbs.
Corn stover	10	"
Corn	5	"
Bran	1	"
Cottonseed meal	1	"

RATION 6.

Corn silage	30	lbs.
Alfalfa hay	12	"
Corn and cob meal	4	"
Dry brewer's grain	2	"

RATION 7.

Corn silage	25	lbs.
Cowpea hay	10	"
Corn	4	"
Cottonseed meal	1	"

RATION 8.

Corn silage	30	lbs.
Clover hay	10	"
Corn	6	"
Distiller's grain (rye)	4	"

If the farmers who wish to feed a balanced ration will write to the Maryland Agricultural Experiment Station, giving a list of feeds available and price of each, the cheapest ration that can be made up of the feeds given will be calculated and returned to them.

BREEDERS' ASSOCIATIONS.

The advantage of breeders' associations have been demonstrated in many communities; and farmers of the same locality, who wish to grade up their herds, are organizing themselves into breeding associations as the cheapest and most effective way of developing a high grade herd.

The plan of operation is briefly as follows: Each member of the association buys one share of stock for each cow or heifer of serviceable age. The price of the stock is five dollars per share. The proceeds from the sale of stock are used for the purchase of bulls required by the members of the association. Only pure bred bulls of the breed selected by the association, and from dams of known merit are purchased. The business of the association is transacted by a board of directors, who purchase the bulls and select the places where they shall be stabled.

The advantages to be derived from these asociations are easily understood. The members of the association have the services of a pure bred bull from high producing dams for at least eight years for less than the cost of one bull. The evil effects of inbreeding are avoided by the use of different bulls. The highly prepotent bulls of any breeds are very rare; and they are usually disposed of before their heifers are in milk and their exceptional value realized. In a breeding community the bulls are kept in the neighborhood until their worth is known by the performance of their daughters. If they prove of unusual value, they are still available to the members of the association. In a very few years a mixed herd of ordinary production can be developed into a high grade herd of large production and uniform in type. For practical purposes such a herd is as good as a herd of pure bred cattle.

Grade dairy cows are eagerly bought at good prices by dairymen who for some reason do not care to raise ther heifer calves, particularly those supplying market milk. Not long ago a herd of 16 grade cows was shipped into Maryland from New York State at an average price of $90.00 per head. For the farmer who sells butter fat, the raising of heifer calves for the market should prove a most profitable addition to his regular farming operations.

PURE BRED GUERNSEY BULL.

PURE BRED GUERNSEY BULL.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION.

BULLETIN No. 170. OCTOBER, 1912.

THE MARYLAND SEED LAW.

By C. P. Smith.

INTRODUCTION.

The quality of seed has been a subject of considerable interest to the public for several years, both in Maryland and in various States of the Union, as manifested by the numerous publications that have appeared. That this subject still needs the attention of Government and State officials, as well as of buyers and dealers in seed, is evidenced by the seed analyses that are being reported from time to time. The quality of seed on the market depends upon two important factors, adulteration and germinative power, when the seed concerned is supposed to be that of some particular sort, and not a mixture of two or more kinds intended for special purposes. Adulteration implies that two or more kinds of seeds are included in the bulk supposed to consist only of the seed of some particular kind or variety of plant. Skillful adulteration is where the vagrant seed is very similar in size, form, and color to the seed for which it is more or less substituted, while, in the case of crude adulteration, seeds of dissimilar characters are included. The former is evidently wilful adulteration, while the latter may result from lack of care and interest, or lack of proper equipment for sorting and cleaning on the part of the producer, agent, or dealer. In either case the buyer gets for his money something other than that which he wishes and may introduce into his fields or garden undesirable plants that may become pests on his own land, and, perhaps, spread to surrounding territory. Very many of our most noxious weeds, as well as many of our less objectionable ones, have come to us from the old country in just this way.

SEEDS IN BULK.

Seeds in bulk are more apt to include, naturally, foreign seeds, etc., as the stock is usually grown under conditions in which clean cultivation cannot be practiced. Thus under the present conditions the pre-

valence of numerous weeds in our seed-growing fields practically guarantees that some of these uninvited plants will mature their seeds at the time that the desired seed crop is ripened and harvested. The process of cleaning, then, must be resorted to, if the stock is to be freed from such impurities. But since relatively few of the weeds, growing with the seed crop, ripen their seeds at the same time as does the crop plant, the percentage of kinds of foreign seeds present in the seed bulk should be low, as a rule. Thus simply lack of care in cleaning, or even entire lack of cleaning, is responsible for the foreign seeds present in the bulk as marketed. Seeds in bulk, as commonly placed on the market, are "graded," the grading being based upon the relative amounts of adulteration present, the price likewise being graded, though not consistently with the amount of adulteration. Professor Norton, of this Station, found that the buyer usually pays more money for the good seed in 100 pounds of the poorest grade than he pays for the good seed in an equal amount of the best grade. Now it commonly happens that the impurities present in these various grades of seeds in bulk are not there as the result of natural or unpremeditated, adulteration; but it is commonly the case that good seed is actually used as the basis to which is fraudulently added inferior material, various in nature, to reduce the actual value and selling price of the stock, and *meet the public demand*. The material used for this purpose of grading is largely the waste or screenings from the cleaning mills of both the United States, Canada and Europe, the importation of this waste material being of no mean proportions. In fact, our own market has been the dumping ground for the low grade stocks and wastes of the seed business of our neighbor on the North, and of most of the European countries. Are we proud of this situation?

GERMINATION.

The germinative value of the seeds we buy and use varies much and is often far from what it should be. In one series of 61 samples of imported red clover seed, analyzed by the Seed Laboratory of our Federal Bureau of Plant Industry, the average percentage of germination was only 43.1. In special cases much lower percentages of germination are obtained. In general, seed should not, however, be expected to show germinating power to the degree of 100 per cent., many agricultural seeds being considered standard if 80 or 90 per cent. of the seed grows, celery being accepted as satisfactory if 65 per cent. grows, and blue grass commonly yielding but 50 per cent. germination. Clovers should, however, show 95 per cent. or better. A table of such standards has been compiled by the Department of Agriculture experts and may be found reprinted on page 236 of Bulletin 162 of this Station.

SEEDS IN PACKETS.

Seeds in packets, both vegetable and flower garden varieties, too often do not germinate a large enough percentage to pay for the planting. This varies much with the seedman, but the Federal Seed Laboratory concludes that, "The quality of such seed is poor." This does not seem to be putting it too strongly when the same writers can record average germination of 62.2% for 2778 packets, representing 26 varieties of plants and 27 seed-packing houses. The products of two firms averaged as low as 37.3 and 44.3 per cent. germination and many lots, from 21 out of 27 packing houses, averaged no more than 10 per cent. These figures indicate much, but one must not base too radical conclusions upon them alone.

DOES IT PAY TO BUY CHEAP SEEDS?

The question may well be asked: Does it pay to buy cheap seed? For the planter, we answer emphatically, *"No!"* For the retailer the answer may vary with the condition; *"Yes,"* if he can get his prices for the lower grades, graded down with waste screenings; *"No,"* if his reputation is valued more, either esthetically, or in connection with competition. The planter, however, is the real sufferer, and pays not only for the seed and waste, but also pays more for the good seed in the lower grade mixture than for the same good seed in the first-class stock. Why then is the cheap seed on the market? Is it not because the planter calls for it? As long as the demand exists, the market must be expected to seek to supply that demand.

SEED LEGISLATION.

Legislation in the seed business, as in any other industry, should not be expected to force the seller to offer for sale better merchandise than the public demands; but the law should certainly rule against fraudulent representation of goods put on the market and also discourage the importation of low grade and waste material from other countries. Since our Federal Government has not yet given us protective legislation in this matter, the only seed laws in our country are those of certain few of our States, but four or five in number. Maryland is now one of the few; her law, approved April 11, 1912, became effective October 1st. The following is the text of the law:

LAWS OF MARYLAND.

JANUARY SESSION, 1912.

CHAPTER NO. 810.

An Act to add five additional sections to Article 48 of the Code of Public General Laws (1904), title "Inspections," to be known as Sec-

tions 51a, 51b, 51c, 51d and 51e, to provide for the examination of seeds sold in the State of Maryland, and to determine their purity.

Section 1. Be it enacted by the General Assembly of Maryland, That five additional sections be and they are hereby added to Article 48 of the Code of Public General Laws of Maryland (1904) title "Inspections," to be known as Sections 51a, 51b, 51c, 51d and 51e, and to read as follows:

51 A. The State Board of Agriculture shall be authorized to obtain samples of seed sold or offered for sale within the State of Maryland, and shall cause the same to be examined and analyzed for the purpose of determining their purity and validity, or any other facts affecting their value for seeding; and shall publish the results of such examination together with the statement of purity of said seed as furnished by the vendor, together with the names and addresses of the persons, firms, companies, corporations or agents from whom such seeds were purchased, and the name and designation under which said seeds are sold, known or advertised for sale or use. Ten days before the publication of the results of the analysis of a sample which is below the standard represented, a report shall be made to the vendor.

51 B. That all seeds hereafter sold or offered for sale in lots of one bushel or more shall be labeled. Said label to contain a statement of the purity and kind of seed, and the amount of foreign matter. Section 51A and 51B shall not apply to seeds sold for food or manufacturing purposes or to seeds marked "uncleaned," or to lawn grass or pasture mixtures.

51 C. Any resident of Maryland desiring an analysis of seed may submit samples of the same to the State Board of Agriculture for the purpose hereinbefore mentioned, and if said samples are of seed purchased or sold, then the same shall be drawn from the whole quantity so purchased or sold at the time of actual delivery of said seed to the buyer, or their representatives, and of a third person, and said samples shall be divided into three parts, one to be sent to the State Board of Agriculture for analysis, as hereinbefore mentioned, and the remaining two parts to be held one each by the buyer and seller, to be available for all in the event of dispute as to the analysis.

51 D. For the purchase of seed as provided for in Section 51 A of this Act, and for carrying out the provisions of this Act, the sum of two thousand dollars for each of the years 1912 and 1913 is hereby appropriated from any money in the Treasury not otherwise appropriated.

51 E. All Acts or parts of Acts inconsistent with this Act are hereby repealed.

Section 2. And be it enacted, That this Act shall take effect October 1st, 1912.

Approved April 11, 1912.

	P. L. Goldsborough,
THE	*Governor.*
GREAT	Jas. McC. Trippe,
SEAL	*Speaker of the House of Delegates.*
OF	Jesse D. Price,
MARYLAND.	*President of the Senate*

State of Maryland, Sct.:

I, Caleb C. Magruder, Clerk of the Court of Appeals of Maryland, do hereby certify, that the foregoing is a full and true copy of the Act of the General Assembly of Maryland of which it purports to be a copy, as taken from the Original Law belonging to and deposited in the office of the Clerk of the Court of Appeals aforesaid.

In testimony whereof, I have hereunto set my hand as Clerk and affixed the seal of the said Court of Appeals, this 6th day of June, 1912. C. C. Magruder.

OBJECT OF THE LAW.

The law thus aims to protect the farmers and truck crop growers of the State from unreliable information, or entire lack of information, concerning the seed they buy. No one is hindered from buying or selling seeds as he did in the past, except that the dealer must label all lots of seeds of one bushel or more, the label to tell the story of the condition of the stock. No such protection is given to the home-garden maker, who buys his seed by the pound, fraction of a pound, or packet.

ANALYSIS OF SAMPLES.

The law provides for proper determination of the quality of seed on sale in Maryland by authorizing official inspection and analysis of seeds and appropriating funds for the support of the work. All results of analysis are to be published, together with all information concerning each sample that properly bears upon the case. When the examination does not find the information on the label to represent the fact, the dealer is to be informed of the intended publication ten days before such is made. This gives him a chance to explain any misunderstanding that may operate unjustly against him.

TAKING OF SAMPLES.

Any resident of the State may submit samples for analysis, no charge being made for the service. The sender should note, however, that if the samples are of seeds either bought or sold, that each sample

must be truly representative of the lot from which it comes, and be taken in the presence of both buyer, seller, and a third person.

HOW MUCH TO CONSIDER A SAMPLE.

The amount of seed necessary for any one examination varies with the kind. The following table gives the minimum quantity required by this laboratory for making its analyses and tests:

One Ounce or Two Tablespoonfuls	Two Ounces or Four Tablespoonfuls	Five Ounces or a Medium-Sized Cupful
bluegrass	timothy	oats
red-top	millet	barley
alsike clover	red clover	wheat
white clover	crimson clover	corn
lettuce	alfalfa	peas
onion	radish	beans
cabbage	turnip	

Three times these amounts should therefore be taken in the original sample, as the law requires this to be divided into three parts, one part to be retained by each the buyer and seller, and the other to be sent to the official seed laboratory.

HOW TO SEND SAMPLES.

Samples should be sent by mail prepaid. The regular postal rate for seeds is one cent for each two ounces or a fraction thereof. These should be inclosed in a strong paper envelope, or other safe wrapping, and be securely fastened. Samples should be plainly marked so as to answer the following questions fully:

Name and address of sender?
Date of sending?
Kinds of seed?
Brand name and number? (if any.)

Then write a letter stating the number and kinds of seeds forwarded, and state the exact purpose for which they are sent, *i. e.*, whether for one or more of the following tests:

1. Examination for presence of dodder or other adulterations.
2. Determination of mechanical purity.
3. Test for germination.

The examination for dodder, etc., takes but relatively little time and will receive more prompt attention than either of the following.

The test from mechanical purity requires the separation of the sample into three parts, as follows:

1. Seed of the kind supposed to be present.
2. All seeds not supposed to be present.
3. Inter-material, such as sticks, stones, dirt and chaff.

Each of these parts will be weighed and the foreign seed identified. This test requires more time and cannot be reported as promptly as the foregoing.

The test for germination is a determination of the percentage of the seed that will germinate under favorable conditions. It also takes time.

All tests will usually be made and reported in the order in which they are received.

WHERE TO SEND SAMPLES.

As stated in the text of the law, the work therein authorized has been entrusted to the Maryland State Board of Agriculture, which board has appointed the present writer Seed Analyst and Inspector. Samples and kindred communications should therefore be sent to the

SEED LABORATORY,
STATE BOARD OF AGRICULTURE,
COLLEGE PARK, MD.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION

BULLETIN No. 171. DECEMBER, 1912.

POULTRY NOTES.

By Roy H. Waite.

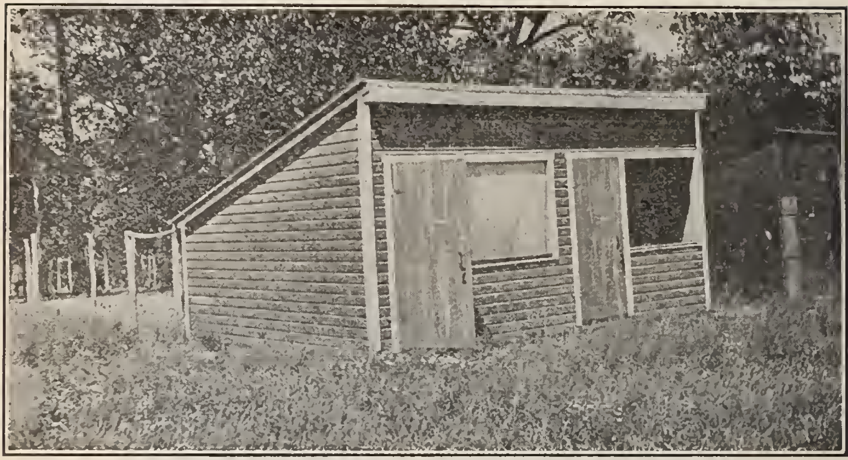
INTRODUCTION.

The writer, during the two years he has been connected with this Station, has taken numerous pictures of poultry subjects. Certain prints of these that have been carried in a pocket note-book on journeys throughout the State, were found to be very useful to explain and answer questions and illustrate ideas. From this experience the idea was formed of publishing these in a bulletin along with a brief discussion, thus making them available to the public.

It is expected also that this bulletin will assist in answering many inquiries that come to the Station.

The opportunity is also taken to report the progress made in certain experiments that are under way, but are not far enough advanced to warrant publication as separate bulletins.

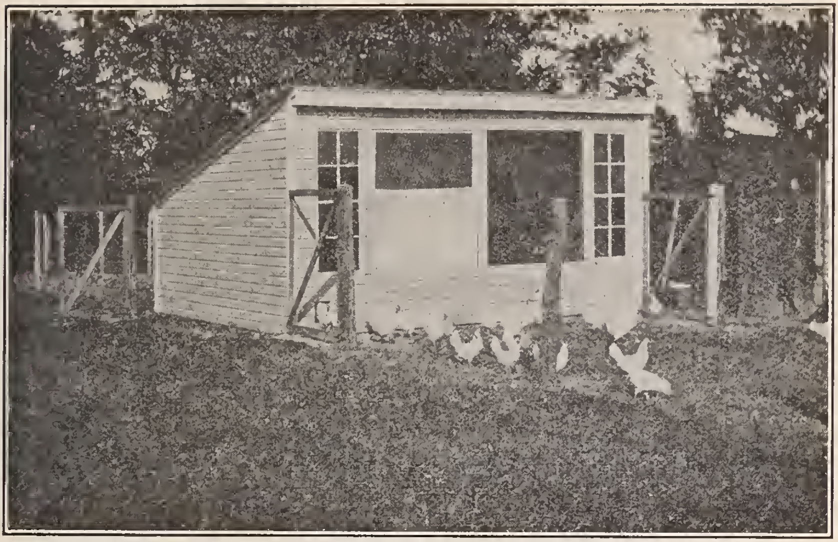
All of the photographs are original with the writer, but for much of the other material no claim for originality is made and the origin is so obscure that it is impossible to give credit.



An Unsatisfactory Poultry House.

This photograph shows a type of house and yarding system that has given very unsatisfactory results. Light is shut out by the doors in front and the openings are so small that they do not admit enough light to make the place cheerful to the birds. The sun, one of the best and cheapest disinfectants obtainable, cannot enter properly, as the openings are low from the top and high up from the bottom. There are no front or south yards and the north runs are all that are available, both summer and winter. When the north openings are used in winter to allow the birds access to the yards, an undesirable draft occurs and the yards are shunned by the fowls on account of their cold and damp condition. Also with this single yard system it is impossible to keep anything growing in the runs to furnish green feed to the birds and sweeten up the ground. The gate is also extremely unhandy, being at the lower end of the yard.

(See next page.)



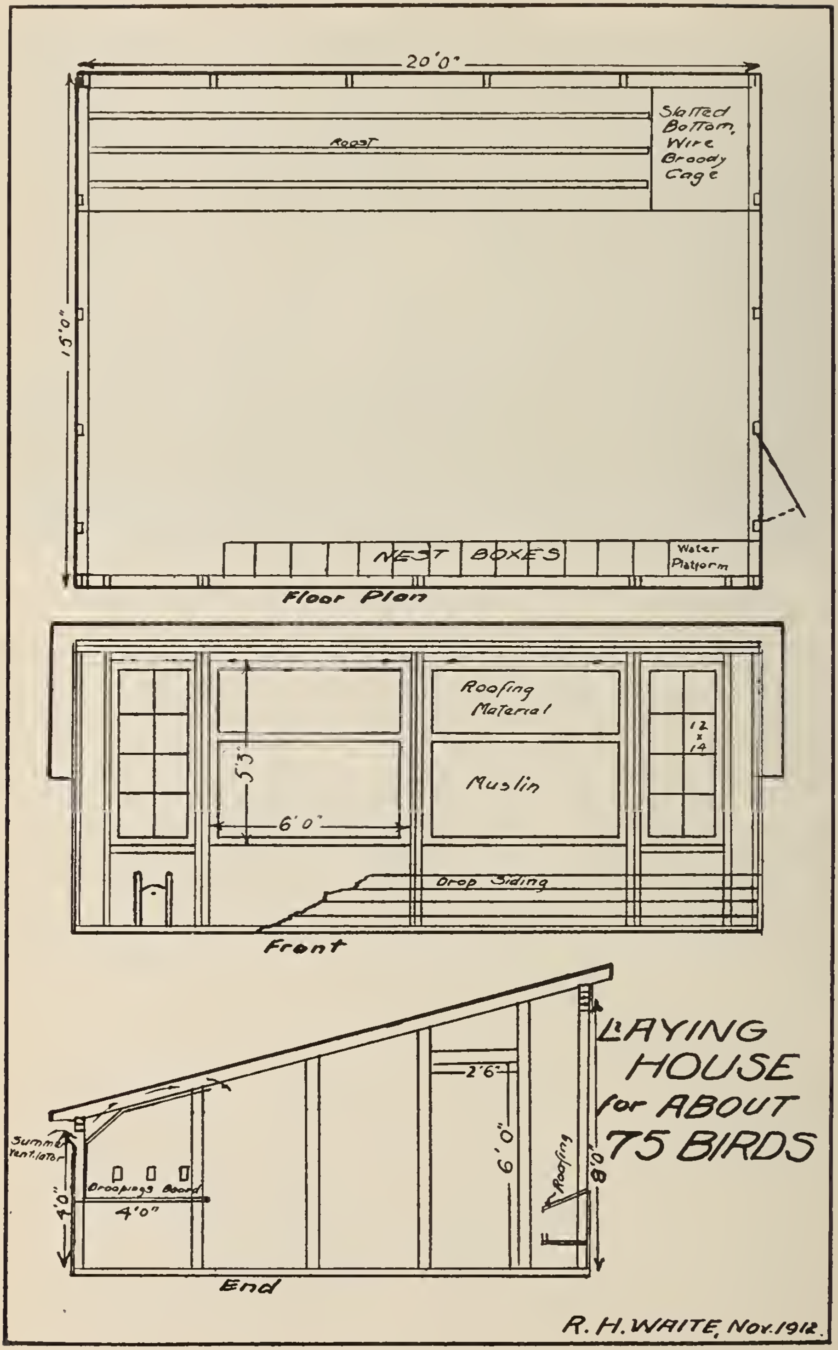
Remodeled House.

This picture is of the same house shown on the preceding page, but was taken after remodeling. High openings were made in the front, in order to admit sunlight to the back part of the house. The two windows were put in to admit light and at the same time give protection to the ends of the house. The two large center openings are fitted with muslin-covered screens, the top part of which are covered with roofing, so that when the curtain is used during cold weather the openings are reduced in size. The door was placed at one end, where it is much more convenient. A south yard was added and the gates of the rear yards were brought up close to the house, where they are more convenient.

In case several pens of this type were put together to make a long house, a door would be put in each partition and one window in each section would be replaced with a glass door.

Bill of material for construction:

11 pieces 2 in. x 4 in. x 16 ft.	2 pieces ½ in. x 8 in. x 16 ft.
14 pieces 2 in. x 4 in. x 10 ft.	3 pieces 1 in. x 6 in. x 10 ft.
6 pieces 2 in. x 4 in. x 12 ft.	500 feet drop siding.
11 pieces 2 in. x 6 in. x 18 ft.	750 feet matched flooring.
6 pieces 1 in. x 4 in. x 14 ft.	2 storm sash 2 ft. 6 in. x 5 ft. 3 in.
9 pieces 1 in. x 4 in. x 12 ft.	5 squares roofing.
2 pieces 1 in. x 4 in. x 18 ft.	5 cu. yards gravel.
5 pieces 1 in. x 2 in. x 12 ft.	6 barrels cement.
2 pieces 1 in. x 12 in. x 16 ft.	Nails, hinges, paint, etc.


20'0"
Slatted Bottom, Wire Broody Cage
Roost
15'0"
NEST BOXES
Water Platform
Floor Plan
Roofing Material
Muslin
5'3"
6'0"
12 x 14
Drop Siding
Front
LAYING HOUSE for ABOUT 75 BIRDS
2'6"
6'0"
8'0"
Roofing
Summer Ventilator
Droppings Board
4'0"
4'0"
End
R. H. WAITE, Nov. 1912.

Interior of Remodeled House.

This picture is of the interior of the house shown on page 83 and shows the large amount of sunlight that enters to make a cheerful working place for the birds. A type of rat proof, non-wasting, hanging, dry mash feeder used at the Station is also shown. Rats and mice starve to death in this house, for all the feed is stored in the two metal cans shown on the wall, and the mash hopper being out of reach, they can get practically nothing to eat unless the birds are overfed with grain in the litter.

The shelf on which the water vessel is kept is also shown. This shelf is placed at such a height that litter is not scratched into it. It is convenient to the door, and does not occupy floor space. A stamped-out galvanized iron refrigerator pan is used for water, as it is inexpensive, holds a good quantity of water, is readily cleaned, as it has no seams, and is convenient at all times to the fowls and for the attendant.

The floor is of cement. It is kept littered preferably with straw, though shavings, leaves, etc., may be used. Cement floors are very satisfactory on account of their durability, freedom from bottom drafts, easiness with which they are cleaned and disinfected, and they are rat-proof, warm and dry when properly constructed. When laying cement floors on land likely to be damp, break up the capillarity by first putting in a four to six inch layer of course material like rock, very course gravel, broken bricks, etc., or put in a layer of tar building paper.

North Side of Poultry House in Spring.

Do not depend on north yards for winter runs for poutlry. The above photograph was taken during the spring of 1912, on a day when the south runs were as dry and warm as one could wish, but had the fowls been forced to use the north yards it would have been necessary for them to wade through deep snow in order to get to cold, damp and cheerless runs.

South Side of Same House, Same Day.

Small Poultry House.

This is a very inexpensive and up-to-date small house for the "back lotter," designed and built by the writer in a few minutes of his spare time. This house is nine feet wide, fifteen feet deep, eight feet high in front and four and one-half feet high in the rear. The droppings board is placed across the back and is twenty-eight inches from the floor. Two roosts are used and the building will accommodate from twenty to thirty birds. No frame work was used except two by fours around the top and bottom and across the bottom of the front opening. The walls were constructed of twelve inch boards and battens three inches wide over the cracks between the boards. The roof is supported by one rafter in the middle and the roof boards run clear across, making it light and very strong. Common roofing material is used as a covering. The floor is of dirt, but either a wood or cement one can be added very easily.

List of material:

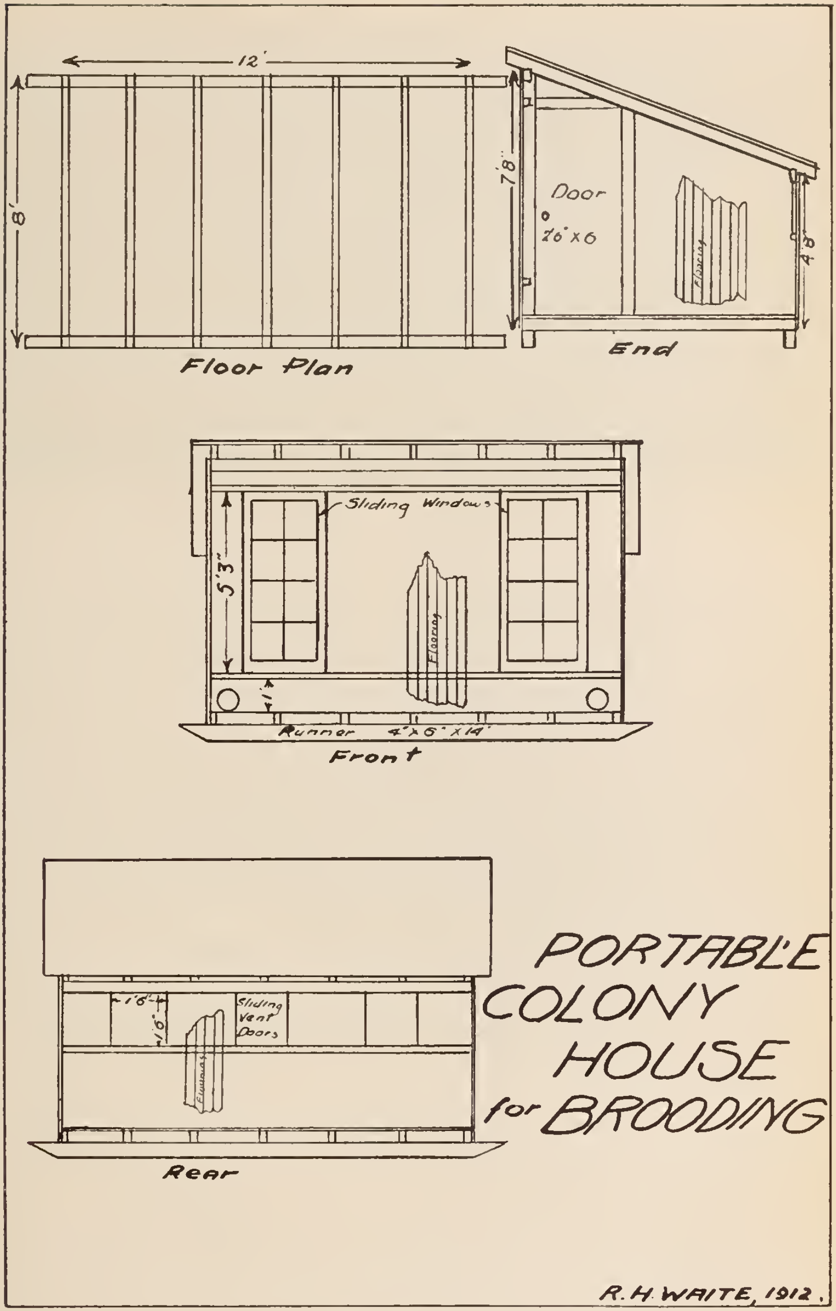
18 pieces 1 in. x 12 in. x 12 ft.	5 pieces 2 in. x 4 in. x 16 ft.
25 pieces 1 in. x 12 in. x 10 ft.	8 pieces 2 in. x 4 in. x 10 ft.
1 piece 1 in. x 12 in. x 16 ft.	2 squares roofing.
20 pieces 1 in. x 3 in. x 12 ft.	Nails, 1 pair hinges, paint or whitewash, etc.
6 pieces 1 in. x 3 in. x 10 ft.	

Young Chicks on Free Range.

Very young chicks are shown enjoying free range in a shady orchard. While chicks will usually withstand confinement indoors, during the first three or four weeks of their lives, they will do better if let out on the ground within one week after hatching. Great care must be observed to train them to go back before they get chilled, for at this age they are rather tender, and if neglected even for an hour great and irreparable damage is apt to occur.

These chicks are housed in a type of portable brooder house, the plans of which are given on the following page. Two hovers are put in this house and fifty or less (never more) chicks are started in each hover. A wire partition of one-half inch mesh and low enough so that it can be stepped over easily by the attendant is used to separate the two broods until they learn their place.

As the chicks grow, first the heat is taken out, then the hover, and when they are old enough to roost, the brooder is taken out and roosts put in. The cockerels are removed and the remaining pullets occupy the house until time to be placed in their winter quarters.


12'
8'
Floor Plan
7'8"
Door
2'6" x 6
Flooring
4'8"
End
Sliding Windows
5'3"
Flooring
1'
Runner 4" x 6" x 14'
Front
1'6"
1'6"
Sliding Vent Doors
Flooring
Rear
PORTABLE COLONY HOUSE for BROODING
R. H. WAITE, 1912.

Enjoying the Shade of an Orchard.

During certain days in spring and summer, when the scorching sun is beating down and making everyone and everything uncomfortable, shade must be provided for the young growing chickens. The above photograph, taken during July, 1912, shows a section of a flock of White Plymouth Rocks taking advantage of the shade in the orchard in which they are being reared. An orchard makes an ideal place for growing vigorous pullets.

When Leghorns, or any of the lighter and more active breeds, are kept in an orchard some provision must be made to keep them from flying into and roosting in the trees, or considerable difficulty may be had in getting them to winter quarters. Clipping one wing as soon as they show signs of flying is one means and is very effective.

List of material for house on preceding page:

2 pieces 4 in. x 6 in. x 14 ft.	
4 pieces 2 in. x 4 in. x 16 ft.	2 squares roofing.
5 pieces 2 in. x 4 in. x 12 ft.	2 storm sash 2 ft. 6 in. x 5 ft. 3½ in.
3 pieces 2 in. x 2 in. x 12 ft.	Nails, hinges, latches, paint, etc.
650 feet flooring.	

White Leghorn Young Stock Just Before Sexes Were Separated.

This photograph is of a flock of young growing White Leghorns. The young cockerels were removed from the flock the day after this picture was taken, in order to reduce the size of the flock and thereby give the pullets a better chance to develop.

Certain of the cockerels that gave indications of being of use for breeders were retained and kept in a separate inclosure, while the remainder were sold as broilers weighing from one and one-quarter to one and three-quarters pounds.

It is best, whenever possible and practicable, to take the males from the flock as soon as their sex can be determined. They should under no conditions be left until they chase and bother the pullets.

In order to properly develop the cockerels that are kept for breeders they should have equally as good care and quarters as the pullets. They cannot be expected to make the best breeders if grown in small bare yards and neglected.

Shelter for Growing Chicks and Miscellaneous Purposes.

This is a small colony shelter made from left-over lumber from the construction of one of the larger buildings. Such houses as these come in handy for numerous purposes, as well as making excellent shelters for growing chicks after they have passed the brooder stage. They are made six feet long, three feet wide, three feet high in front and two feet high in the rear. An opening is left in both front and back and covered with wire. These openings are on a level with the two roosts used and allow the warm air to be driven out during hot summer weather. During colder seasons the rear opening can be closed by means of a hinged door or a board can be nailed over it. The floor, to facilitate cleaning, is simply a three by six platform, on which the house rests. The house can be cleaned from the front door, or the whole top tilted back out of the way during the process. The roof covering is common roofing material. The capacity of this house is from twenty-five to thirty half-grown chicks.

List of material:

1 piece 2 in. x 4 in. x 10 ft.	7 pieces drop siding 12 ft. long.
2 pieces 2 in. x 2 in. x 10 ft.	65 sq. ft. flooring.
1 piece 2 in. x 2 in. x 12 ft.	14 foot length of roofing.
2 pieces 1 in. x 3 in. x 12 ft.	Nails, hinges, paint, etc.

Coop for Hen and Her Brood.

Above is pictured a very inexpensive and satisfactory coop, which is used at the Station for a shelter for a hen and her brood. This particular coop is constructed from material taken from dry goods boxes, a piece of roofing and a small piece of wire cloth.

The door is made to slide and can be entirely closed, opened to let out the chicks or opened to let out both hen and chicks. This coop can be used on a platform and the front closed tightly at night in places where rats are troublesome.

Details of size and materials necessary for construction are as follows:

Size 2 feet by 3 feet, 2 feet high in front and 1 foot high in rear.

2 pieces 1 in. x 12 in. x 10 ft.	Wire cloth, 2 ft. x 2 ft.
2 pieces 1 in. x 2 in. x 12 ft.	Roofing, 4 ft. length.
1 piece 1 in. x 3 in. x 4 ft.	Nails, etc.

Hens for hatching and brooding are to be recommended where it is convenient to use them, for as a rule naturally raised chicks are much more vigorous than artificially raised ones. Of course, where large numbers are being raised, or when hatching is being done out of the natural season, artificial means are a necessity.

Taming Pullets.

Fowls to produce well must be kept tame, and the above photograph shows one method of accomplishing this. At feeding time, when the birds are hungry, and you have from one to five minutes time that can be spared, sit or kneel down at the usual feeding place with the bucket of feed and throw out a little of the feed near you, gradually shortening the distance from day to day. In this way the birds may be made to approach rather close, and after a few trials they will usually eat from one's hand.

This flock of so-called wild Leghorns were so tame at the time of going into winter quarters that they were simply driven in like so many sheep and, not being disturbed to any extent, there was no break in the egg production.

Gentleness at all times must be observed if good results are to be obtained. Laying fowls, like bees, sting when disturbed by quick motions or otherwise, the only difference being that the sting is in the pocketbook. Avoid hasty passing by windows or openings of poultry houses and do not enter suddenly. Sometimes it is well to rap on the door to draw the birds' attention, so that they will not be taken by surprise and pile into a corner or try to get out by way of the roof. When walking among the birds, do so with a slow, deliberate step. It is also a good practice to call the birds to their feed with a low whistle and to use this same whistle when entering the pen, or when the birds are disturbed in any way.

Cultivating Yards

This photograph shows the method of cultivating yards at the Station plant. Each fall the birds are shut out of the north yards, the south, or warmer ones, being used during the fall and winter. Advantage is taken while the birds are out to get something growing for use as a pasturage during the spring and summer seasons, when the north runs are used.

During the first part of October the ground is thoroughly stirred up with a one-horse cultivator, and rye is sown rather heavily. Rye is used because of its hardiness and its ability to withstand pasturage. From one to two bushels per acre are sown.

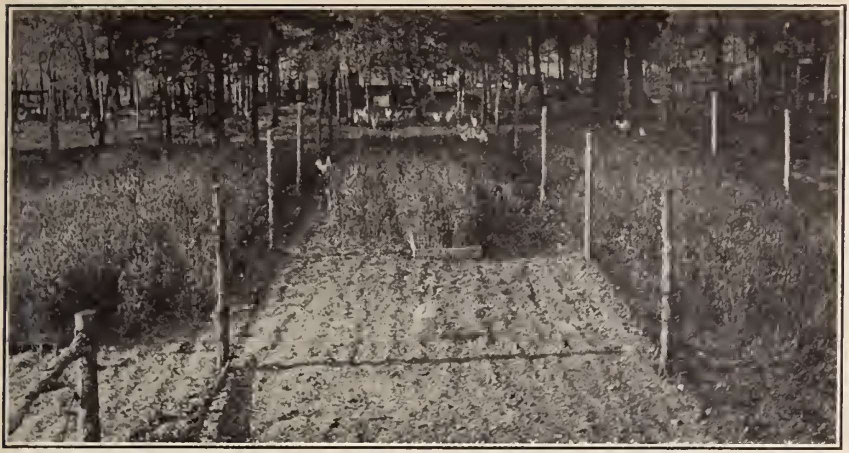
Growing things of this sort tends to keep the ground in better shape for poultry, as the plants take up a great deal of the organic material from the droppings which have accumulated. The stirring and the exposing of it to the action of the sun and air, together with the washing of the rains during this period of rest also helps to keep the land "sweet," as termed by poultrymen.

In cases where large yards are used rather than single runs more rapid methods of preparing and sowing can be used, as a two-horse team and farm implements, rather than the one-horse or mule outfit, which works best in narrow quarters.

Summer Runs of Hens Whose Rations Contain No Bran.

The Station is practicing the double-yard system of runs. The south yards are well seeded to blue grass and are used mainly during the late fall and winter, although the birds are turned in occasionally a few minutes at a time during the summer. During the spring and summer the north yards are used while the grass is allowed to make a growth in the south ones. This lying idle, together with the rains, sunshine and growth of vegetation, keeps the ground in good shape for the birds. It is impossible to keep the north yards in grass; therefore, rye is sown in the fall (about the first of October), and furnishes spring pasturage.

The photographs on this and the following page were taken on the same day and show how certain feeding affects the desire for green feed. All five yards were seeded at the same time in the same manner, with the same sample of seed, and made about the same growth before the birds were turned in. Each pen also contained the same number and variety of fowls of the same age, viz., White Leghorn pullets. The birds having the run of the two yards pictured on this page received no bran in their ration, while those running in the yards shown on the next page did receive bran in considerable quantities.

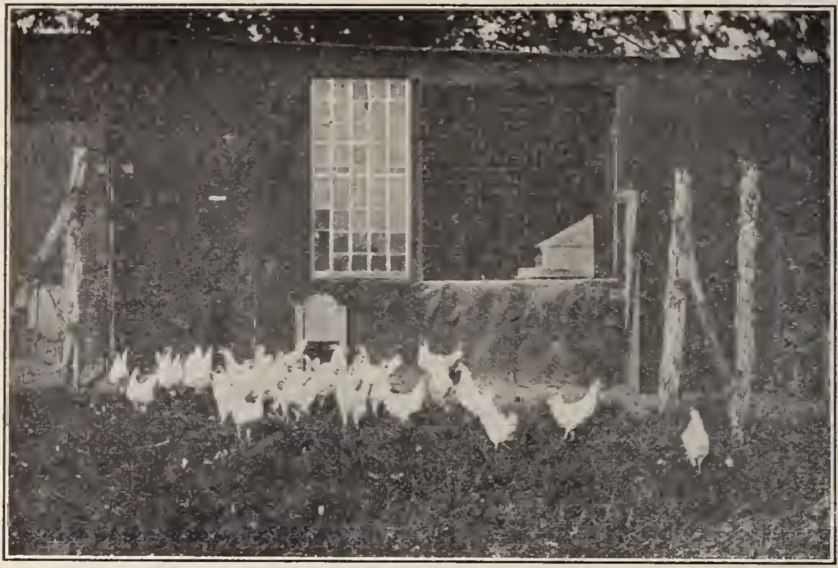


Summer Runs of Bran Fed Hens.

The results seem to indicate that bran to a considerable extent takes the place of green feed, or perhaps it would be better to say, fowls receiving a good proportion of bran do not require so much green feed as those fed without bran. This subject will be discussed in greater detail in a later bulletin after the work has progressed further.

The frames shown in the center of the yards are covered with wire, and were expected to protect the roots of the rye from the fowls, and thus keep a source of constant, although limited, amount of green feed for them to pick at. They, however, proved an absolute failure in this case, due to the fact that two-inch mesh wire was used as the cover, and the birds were able to get their heads through and pick off the roots. This wire will be changed to one-inch or one-half-inch mesh, and then, without doubt, the frames will serve their purpose. Their dimension is six inches by three feet by sixteen feet.

The large amount of shade shown in the back of the yards is a very decided advantage in this climate during the summer.



170 Egg Flock.

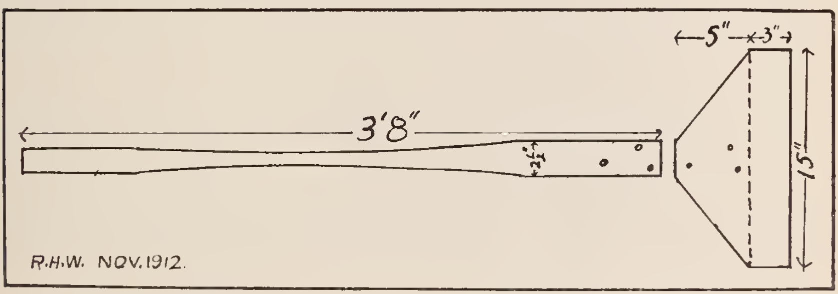
Forty yearling Single Comb White Leghorns, which produced 6,831 eggs during their pullet year, making an average per hen of 170.8.

This pen is one of five that are in a feeding experiment. The results of all the pens during the period from November 1st, 1911, to October 31st, 1912, are tabulated below. The work is still under way, and no conclusions will be stated until the experiment is reported more fully at a future date.

	Totals—Nov. 1-11 to Oct. 31-12.					Averages.				
Pen No.	2	3	4	5	6	2	3	4	5	6
No. Hens.	39.54	39.43	40.	40	40	1	1	1	1	1
No. Eggs.	5571	6139	6831	5086	6587	140.9	155.7	170.8	127.1	164.7
Corn.	1265.50	—	641.80	1872.70	—	32.0	—	16.04	46.82	—
Wheat.	—	1832.14	919.88	—	2175.20	—	46.49	23.0	—	54.38
Bran.	823.20	843.36	834.24	—	—	20.82	21.39	20.86	—	—
Gluten Meal.	548.80	—	278.08	—	—	13.88	—	6.95	—	—
Beef Scrap.	274.40	281.12	278.08	561.90	501.10	6.93	7.13	6.95	14.05	12.53
Salt.	8.23	8.43	8.34	—	—	.21	.21	.21	—	—
Oyster Shell.	146.70	149.60	148.80	74.30	136.00	3.71	3.79	3.72	1.86	3.40
Grit.	36.05	50.30	69.10	35.90	49.10	.91	1.27	1.73	.90	1.23

Droppings Board Scraper.

A home-made droppings board scraper, designed by the writer and used at the Station, is shown. The materials used for its construction are a sheet of seventeen gauge galvanized iron, eight inches by fifteen inches, cut as shown in drawing, three, one and one-quarter-inch stove bolts and a piece of three-inch flooring.



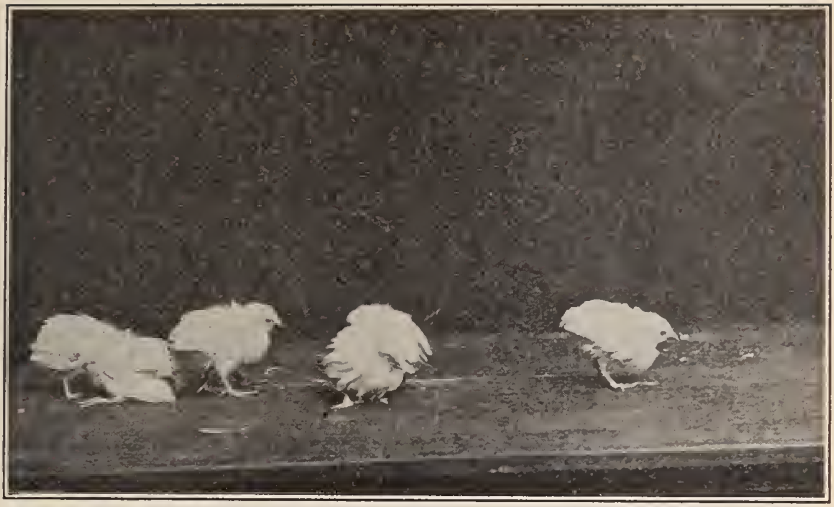
The advantages of a scraper of this type are efficiency, due to its width, cutting quality, and its shape, which allows it to be used close up in corners. It is very light and convenient to carry from pen to pen, and its rounded flat handle, which fits the hand, makes it easy to use. A common bushel basket used in connection with this implement makes a very light, convenient, inexpensive and efficacious outfit for removing droppings from the roost boards of small and medium-sized poultry establishments.

Bird Operated Upon to Relieve Impaction of the Crop.

Fowls that have been closely confined for some time should be gradually accustomed to a grass range when one is to be used, otherwise unfortunate results are apt to occur. The above photograph is of a White Plymouth Rock hen that ate grass so ravenously that her crop became impacted with it and she became crop-bound. Her condition, however, was discovered in time and she fully recovered after a simple operation was performed to remove the material, which is shown in the upper right-hand corner of the photograph.

An incision was made, about one and one-half inches in lengths, through the skin and into the crop well up toward the oesophagus, so that the resulting wound would interfere least with the passage of food through the crop, and the contents were removed with a bent wire. The crop and wound were then cleaned carefully with water, after which the incisions in both the crop and outer skin were sewn up separately by means of stitches of clean silk thread. The bird was then kept up and fed soft feed for several days and, recovering fully, was returned to the flock.

Often in cases of impaction the crop contents consist of grain or such other material as can be forced out by first giving a little oil as a lubricant and then holding the bird head down under the right arm with the right hand manipulating the crop, while the left hand straightens the neck. Water given occasionally during this process often assists in removing contents.



Leg Weakness Caused by Lack of Ash in the Feed.

Typical cases of leg weakness in young chicks are shown in the photograph on this page. These are chicks from a lot fed on a feed low in ash, due to its having been balanced by use of a meat meal containing very little bone. Young chicks grow so rapidly that they require a great deal of bone-forming material to support the body. Another lot from the same hatch was kept in the same house and fed exactly the same, except that they had access to ground or granulated bone. At the time the above picture was taken not a chick in this latter lot showed a sign of weakness. Ground dry bone costs very little for quantities required by young chicks, and the above results indicate that it is well to have it before the chicks as a sort of insurance.

More work has been and is being done on this problem, and the subject will be discussed more fully in a later publication.

Leg weakness is often also caused by confinement indoors, a lack of green feed and certain digestive disorders. Bottom heat in brooding is also said to give rise to this trouble.

Tumors.

This photograph shows a few of the thirty tumors which were on a Salmon Favorite cock bird that was brought to the Station for treatment. There is no remedy known for cases of this kind; therefore, the brid was killed, plucked and photographed. While the disease probably is not infectious, it possibly is transmitted by inheritance; therefore, it is not advisable to breed from birds in which this disease makes an appearance.

Celloidin sections from one of these tumors were made by Dr. B. M. Bolton, Biologist of the Station, and his diagnosis and description of these is as follows:

a. endothelial cell nests. b. connective tissue bands.

c. Fat tissue.

"The sections from the tumor under the lower power of the microscope show bands of connective tissue which form more or less distinct alveoli. The alveoli are filled with collections of round cells, which are relatively large and have rather lightly stained vessicular nuclei. They seem to infiltrate the connective tissue bands in different places. It would seem appropriate to class this tumor as lymphangioma."

Schedule—Feeding Young Chicks at the Maryland Experiment Station—Spring of 1913.

First 24 to 48 hours—*Nothing.*

First few feeds—Rolled oats or oatmeal and hard-boiled eggs (infertile ones from the incubator) shell and all ground up in a food chopper.

Up to about three weeks of age:

Mash Mixture.		Grain Mixture (Scratch Feed).	
Bran	4 parts	Finley Cracked Corn	1 part.
Corn Meal (or Hominy Chop)	2 parts.	Cracked Wheat	1 part.
Middlings	2 parts.	Hulled Oats	1 part.
Beef Scrap (Sifted)	1 part.		
Salt, ½ lb to each 100 lbs.			
Nutritive Ratio is About	1:4	*Nutritive Ratio is About*	1:7
Ash Content is	4.5%	*Ash Content is*	2%

Above two mixtures, the mash fed in shallow troughs twice daily (about 10 A. M. and 4 P. M.) and the grain in a litter of cut straw three times daily (early in the morning, noon and late in the evening). At first the mash may be moistened slightly with water, but feed dry as soon as chicks learn to eat it readily. The egg and oat meal may be given occasionally as a relish. Regulate the feeds so that the chicks are hungry at each feeding time, but be certain that they are not starved. Little and often is the rule with young chicks until they get to going well.

From three weeks to maturity:

The same mash given above (beef scraps need not be sifted) fed dry, once daily, at noon, in outdoor hoppers, and a scratch feed composed of whole wheat and ordinary sifted cracked corn, equal parts, given twice daily (morning and night). If the birds are able to obtain a large amount of animal feed for themselves from insects, worms, etc., the proportion of beef scrap may be cut down. Also cut down beef scrap if birds show too rapid maturity, as indicated by comb, development, etc.

Green Feed—Give green feed in the form of cut green clover, grass lettuce, certain weeds, etc., during the first few weeks, unless they are able to pick their own from the range.

Water—Keep clean water (changed twice daily) before them at all times; also fine grit after the first few days.

(Note—If animal meal is used in the place of beef scrap, or if most of the bone is sifted from the beef scrap, it is necessary to use a small amount of bone meal or ground bone in the ration.

RATION FOR ADULT FOWLS.
MARYLAND AGRICULTURAL EXPERIMENT STATION, 1912-13.

Mash:

Bran	200 lbs.
Middlings (wheat)	100 lbs.
Corn meal (or hominy chop)	100 lbs.
Beef scrap	100 lbs.
Salt	2½ lbs.

Scratch Feed:

Corn (whole) and wheat, equal parts.

Mash is fed dry in troughs or hoppers. The grain is fed in a litter of straw or leaves, morning and night, and the birds are made to work for it. By regulating the amount of grain fed the birds are made to eat fully as much mash as grain by weight. During very hot weather feed the grain on the ground, or where it can be picked up easily. Keep clean water, grit and oyster shell (crushed) before them at all times.

If the fowls do not have green stuff available in their runs, it is necessary to furnish some in the way of cabbage, beets, mangels, sprouted oats, lawn clippings, clover, certain weeds, etc. It might also be well to replace half of the bran in the mash with a good grade of alfalfa meal.

During the moulting period fifty pounds of linseed meal may be added to the mash, and sunflower seeds fed, if they are available.

It is impossible to give any exact amount of feed to use, for it varies with the breed, season of the year, amount of natural feed available and the number of eggs being produced. If a dry mash is kept before the birds at all times there is no excuse for them getting too hungry, and if they are made to eat equal amounts of grain and mash they will not be overfed, for they are not as fond of the dry mash as they are of the grain.

(Note—If a meat meal or a brand of beef scrap containing a very small amount of bone is used it is well to supply bone in some such form as green bone, ground bone or bone meal; also if the birds get large amounts of insects, worms, etc., from the range, less meat feed need be fed.)

THE MARYLAND AGRICULTURAL EXPERIMENT STATION.

BULLETN No. 172. JANUARY, 1913.

IRISH POTATO INVESTIGATIONS FROM 1909 TO 1913.

By Thos. H. White.

Introduction.

The experiments reported herewith have been conducted since the publication of Bulletin No. 132 in February, 1909.

The high prices of Irish potatoes last year, stimulated an increased interest in their culture. This in turn created a large demand for literature on the subject.

The edition of Bulletin No. 132 having become exhausted it has been thought well to publish another, at this time, in which is embodied some of the important facts of the former Bulletin and also the results of experiments to date.

Thanks is here extended to the gentlemen in Garrett County, Maryland, who so kindly assisted us by growing the samples of seed for use in the experiments.

Character of the Experiments.

1. A three year comparative test between seed grown in Maine; Garrett Co., Maryland; and at the Experiment Station.

2. Comparative test of different methods of holding over seed for late planting.

3. Yields of varieties early and late planting.

Yields from Maine Grown; Garrett Co. and Home Grown Seed.

Previous work showing the necessity of procuring seed from cool climates in order to get the maximum yield, it would seem to be economically important to get it as nearby as possible.

An examination of the temperature records of the U. S. Weather Bureau showed that the mean summer temperature of Garrett County, Maryland, were almost as low as that of Aroostook County, Maine. See Table 1.

TABLE I.

Shows Maximum, Minimum and Mean temperatures copied from U. S. Weather Bureau reports at Fairfield, Maine; Deer Park, Garrett County, Md.; and College Park, Md., for the potato growing season.

	Fairfield Maine			Deer Park Garrett Co., Md.			College Park Maryland		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
April........	78	29	45.7	81	15	41.8	84	31	49.9
May.........	85	33	55.	84	25	55.2	85	36	60.8
June	95	40	65.6	89	32	64.4	99	47	69.3
July.........	97	45	70.2	94	46	71.0	98	63	78.2
August......	88	50	68.6	87	44	76.4	97	55	74.4
September ..	89	33	61.8	83	29	58.2	90	37	64.4
Aver., Mean.			61.1			61.1			66.1

This being so, it would look as if Garrett County, Maryland grown seed should produce as good a crop as the Maine grown seed, assuming of course that the cool climate was the principal factor. Therefore in the spring of 1908 Mr. Jas. D. Harvey of Deer Park, Mr. Herman Steidings of Swanton and Mr. J. B. Miller of Grantsville kindly consented to grow, for the purpose of testing this theory, several varieties of seed potatoes. A peck each of the varieties, Irish Cobbler, XX Early and Green Mountain were secured from a Washington seedsman who obtained them directly from Maine. These were sent to the Garrett County gentlemen and were planted in the month of April. At the same time the same varieties and amounts were planted on good soil at this Station.

The harvesting was done in the late summer or early fall in Garrett County and at this Station it was usually the first week in August.

This work was continued for three years and the yields of the different lots are shown in Table II.

TABLE II.

Shows yields of primes and culls in bushels per acre from seed grown in Garrett County, Maryland, Maine and Home grown seed.

VARIETY.	Garrett County, Md.						Maine Grown.						Home Grown.					
	1910		1911		1912		1910		1911		1912		1910		1911		1912	
	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls
Irish Cobbler......................	186.4	44.0	47.3	15.4	221.8	52.2	180.	43.2	49.3	11.6	121.8	34.8	127.	38.4	46.4	14.5	188.5	52.2
XX Early........................	151.2	40.8	70.6	17.4	304.5	60.9	172.	43.2	60.9	8.7	.....	....	108.0	43.2	37.7	17.4	200.1	72.5
Green Mountain..................	232.8	33.4	38.9	9.8	292.9	69.9	211.	40.8	20.3	8.7	253.3	63.8	192.0	38.4	29.9	5.8	246.5	69.9
Average three varieties..........	190.1	39.4	52.2	14.2	273.0	61.3	187.2	42.4	43.5	9.6	187.5	49.3	142.1	40.0	38.0	12.9	211.7	64.8
Average three years........	171.7	38.3					139.4	33.4					130.6	39.2				

The figures show up very favorably for the Garrett County seed.

According to previous work done here much of the poor yield of the home grown seed is due to its diseased condition. The tubers of many varieties planted in the spring and harvested in the summer fail to start out the next season with a good strong sprout. It is to this, no doubt, that much of the poor yield of the home grown seed is due. So far none of this affection has been seen in Garrett County or Maine grown seed.

Another instance outside of these experiments which would indicate that the Garrett County climate is good for potatoes may be cited here as interesting.

In the spring of 1911 Mr. Jas. D. Harvey, of Deer Park, Garrett County, forwarded a sample of the variety Empire State. He said it grew especially well under his conditions and he had been growing it without change of seed for thirty years. It was planted alongside of a sample of the same variety from a dealer in Northern New York.

The growth and appearance of each were almost identical. They withstood the extreme drouth better than many of the other varieties and were the best yielders of that season. The Garrett County seed yielded at the rate of twenty bushels per acre more than the New York seed.

What has been said of Garrett County grown seed is probably true of some of the other mountain districts of Maryland. If the farmers of these regions felt disposed there seems to be no reason why they should not supply the eastern and tidewater counties with as good, in fact, according to the experiments, better seed than Maine. Of course this could better be done by concerted interests so that carloads could be supplied.

Comparative Tests of Methods for Holding Over Seed for Late Planting.

The late crop of potatoes, which is usually planted in the southern and eastern sections of Maryland from July 1st to August 1st is a very important one. When grown on good soil and given good cultivation, with late spraying, the crop is usually large. One of the great drawbacks has been the preservation of the seed to this late date. Closely related to this is the difficulty of getting a good stand. In midsummer, when the temperature is very high, the small pieces of potatoes used for sets will often decay, before the sprout has a chance to take hold of the soil with its rootlets.

If potatoes are kept in an ordinary barn or cellar there is usually much growth during the summer months. Wishing to note the difference between seed stored in the cellar and in cold storage several varieties were procured from Northern New York. On May 3 half of each lot of these varieties was sent to the Centre Market Cold Storage Co. of Washington, D. C., with a request that they store them at a temperature of 34 to 35 degrees Fahrenheit. The other half was placed in a cool cellar.

On June 24th those in cold storage were sent for and were allowed to stand in the barrels under a shed until planting time. On July 3 those that were stored in the cellar were brought out and both lots were taken to the field.

The lots that had been kept on cold storage were quite firm with sprouts half an inch long. Those kept in the cellar were much shrivelled and some of the sprouts were ten inches long. All the sprouts of both lots were removed and the tubers, which were large, were cut to two eyes and planted. The soil was almost ideal in regard to moisture and preparation. One row of 100 feet long of each variety was planted. The cellar stored lot of each variety was planted next to and directly alongside of the cold storage lot. The cold storage lots came up quickly and with apparently a good stand. The cellar stored came up more slowly and were a very poor stand, some varieties being much worse than others.

On July 26 the number of plants were counted in each row. Table III shows the percentage of stand and the yields in bushels per acre.

TABLE III.

Shows per cent of stand and yields of primes and culls in bushels per acre for cold storage and cellar stored seed; season late 1912.

VARIETY.	COLD STORAGE,			CELLAR STORED.		
	% Stand.	Primes	Culls	% Stand.	Primes	Culls
Bovee	94	87.0	23.2	5	5.8	2.9
Irish Cobbler	95	72.5	23.2	21.2	3.2	8.7
Bryan	52	113.1	17.4	00	00	00
Prosperity,	85	220.4	11.6	14	40.6	2.9
Taft	88	185.6	20.3	4	8.7	2.9
Green Mountain	83	243.6	17.4	7	23.2	5.8
Peerless Junior	88	232.0	14.5	5	17.4	5.8
Giant	98	176.9	31.9	53	81.2	11.6
Empire State	91	194.3	26.1	24	66.7	11.6
Norking	85	172.6	29.9	15	11.6	2.9
Carman No. 3	75	116.0	14.5	2	2.9	2.9
Manistee	94	117.0	20.3	17	49.3	2.9
McCormick	....	....	....	98	278.4	29.9

It will be noticed that some of the varieties came up better than others. The variety Giant for instance having 98% stand from cold storage seed and 53% from cellar stored. While Bryan had 50% and no per cent respectively.

Wishing to make a somewhat closer examination into the cause of the poor stand, more cellar stored seed was planted the first of August. Part was cut and part planted whole. These were planted thickly so that they could be easily found and examined. Of those planted whole all apparently came up, but of the cut lot only a few appeared above ground. Upon examination the cut sets were found to be attacked with a soft rot disease that had destroyed the set entirely and had extended in some cases to the sprout which had almost appeared above the ground.

Another experiment bearing upon this matter is a comparison between a lot of home grown fall harvested Green Mountain, treated in different ways. One lot was sent to cold storage; another lot was kept in the cellar and the sprouts allowed to develop, and a third lot was kept in the cellar and had the sprouts removed as soon as they were half an inch long. These were sprouted three times while in the cellar. All three lots had the sprouts rubbed off at planting time.

The yield of these was very low, probably on account of too much rain in the early stages of growth, with too little later on. (See Table IV).

One other experiment similar to the above, except that small potatoes, about the size of a hen egg were planted whole, was tried two seasons. There were two lots planted in 1911; these were in different pieces of land. Only one lot was planted in 1912. (See Table V).

The results as shown in Tables IV and V do not appear to be quite consistent. Taking the average, however, the cold storage seed is the best and the lot with sprouts rubbed off is next, although the difference between those rubbed off and not rubbed off is slight.

TABLE IV.

Shows per cent of stand, also yield of primes and culls in bushels per acre, of fall harvested Green Mountain, large size, cut; stored in cold storage and in cellar, with sprouts left on and rubbed off.

Season Late 1912.	Cold Storage.			Cellar Stored.					
				Sprouts Left On.			Sprouts Rubbed Off		
	% Stand.	Primes	Culls.	% Stand.	Primes	Culls	% Stand.	Primes	Culls
	92	88.4	29.2	47	50.7	12.3	58	50.7	15.9

Table V.

Shows yield of primes and culls in bushels per acre of fall harvested Green Mountain, egg size, whole; stored in cold storage and in cellar, with sprouts left on and rubbed off.

Season Late	Cold Storage.			Cellar Stored.					
				Sprouts Left On.			Sprouts Rubbed Off		
	Primes	Culls		Primes	Culls		Primes	Culls	
1911 A	217.5	34.8	......	176.9	34.8	......	208.8	29.9	......
1911 B	266.8	31.9	......	182.7	29.9	......	168.2	30.1	......
1912	76.2	32.2	......	63.8	26.1	.....	72.5	28.6	......
Average	186.8	32.9	......	141.1	30.2	......	149.8	29.5	......

New Varieties in Early and Late Planting.

There is always much interest in new varieties whether it be of vegetables, flowers, fruits or grains. Nothing we have is ideal, there is always something more to be desired.

This station has tried many varieties of economic plants; but it is very rare that a variety is found very much better than many others. The climatic conditions vary a good deal and some seasons a variety that seems superior will be only average the next year.

This is brought about largely by seasonal conditions. For instance, a variety of potatoes may get just the right amount of water at the proper time one year and the next year the rainfall come later or earlier and thus suit some other variety. For this reason it will be more likely to be correct to take the average of the seasons.

There are a great many varieties of potatoes on the market and new ones are constantly appearing. Since the publication of the last Bulletin some of what appeared to be promising new kinds have been selected and tested.

There seemed to be a necessity for a good variety to plant in late summer. The McCormick, which is of this character, has now been grown a good many years, and is getting well distributed over the lower counties of the state. It is a very vigorous growing kind and very resistant to disease. There is much yet to be desired, however, in its form and quality.

For this reason more attention has been paid to the later varieties. Table VI shows varieties grown and the annual yields of each variety. The records for early and late planting are shown on the same table.

TABLE VI.

Shows yields of primes and culls in bushels per acre of varieties tested in early and late planting.

Varieties.	Early Planting.								Late Planting.					
	1910		1911		1912		Average three years.		1911		1912		Average two years.	
	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls	Primes	Culls
Early Maturing.														
Irish Cobbler	197.0	50.4	49.3	14.5	221.8	52.2	156.0	39.0	121.8	11.6	72.5	23.2	97.1	17.4
XX Early	172.8	43.2	78.4	17.4	304.5	60.9	185.2	40.5	......	.....	......	......	......	......
Roseling	......	......	55.1	11.6	179.8	43.5	......	......	81.3	14.5	......	......	......	......
Good News	......	......	49.3	17.4	......	......	......	......	84.6	11.6	......	......	......	......
Early Hustler	172.8	24.0	69.6	14.5	......	.....	......	......	74.1	11.6	......	......	......	......
Late Maturing.														
Green Mountain	240.0	36.0	52.2	14.9	292.9	69.9	195.0	40.2	205.9	31.9	243.6	17.4	224.7	49.3
Longfellow	172.8	28.8	34.8	5.8	156.6	20.3	118.0	18.3	203.0	26.6	.....	......	......	......
American Giant	199.2	16.8	69.6	7.7	150.8	23.2	139.8	15.9	214.6	23.2	176.9	31.9	195.7	27.5
Million Dollar	156.6	16.8	75.4	11.6	87.0	29.9	106.1	19.4	69.6	5.8	......	......	......	......
Norking	278.4	16.8	95.7	8.7	......	......	......	......	172.6	29.9	......	......	......	......
Prosperity	223.2	48.0	......	......	179 8	37.7	......	......	178.1	20.3	220.4	11.6	199.2	15.4
Carman No. 3	......	......	78.3	8.7	107.3	29.9	......	......	176.9	24.7	116.0	14.5	146.4	19.6
Empire State	......	.....	136.3	17.4	203.0	40.6	......	.....	127.6	24.7	194.3	26.1	160.9	25.4
Enormous	......	......	58.8	8.7	133.4	20.3	.....	......	124.7	17.4	......	......	.....	......
Peerless Junior	......	......	46.4	14.5	81.2	29.9	......	......	241.9	29.0	232.0	14.5	236.9	21.7
Pat Murphy's Choice	......	... ..	72.5	5.8	......	......	......	......	234.4	29.0	......	......	......	......
Manistee	......	......	58.6	5.8	......	......	......	......	150.8	70.4	.....	......	......	......
Stump the World	175.2	12.0	......	......	......	......	......	......	......	......	......	......	......	.....
Wonder	158.4	14.4	......	......	......	......	......	......	......	......	......	......	......	......
McCormick	......	......	......	......	......	......	......	......	......	......	278.4	29.9	......	......
Bryan	......	......	......	......	......	......	......	......	......	......	113.1	17.4	......	......
Taft	......	......	......	......	......	......	......	......	......	......	185.0	20.3	......	......

The early planting was done in April and the late planting in July.

The average yields have been worked out on those varieties that were planted the same number of seasons. The varieties in the early planting that were only planted two years had better be studied individually as the conclusions would be more likely to be correct than if they were compared with the three years average.

Of the early varieties tested XX Early gave the largest average yield. This variety is of the Early Rose type, that is, long rather than round, with a pink skin. It is very popular with the growers in the vicinity of Washington, D. C.

The Irish Cobbler, which was the next best, is also quite popular among growers. It is a roundish white potato with deep set eyes on the terminal end. Some growers object to it for the reason that the eyes are scarce and it therefore takes more seed per acre than the XX Early.

The Early Hustler is very similar to Irish Cobbler but possibly a little earlier.

Of the late varieties, when early planted, Green Mountain heads the list. When late planted, however, Peerless Junior yielded somewhat better and McCormick was better than either. The McCormick variety has been known to Southern Maryland growers some twelve to fifteen years. Until recently it has not been handled by potato dealers. It is said by some to be a variety of the German Peachblow.

Its habit of growth is somewhat distinct from the ordinary potato in that the tops are very stiff and erect. It also blossoms freely and the flowers are light purple in color. Seed balls set freely.

It succeeds best when planted in midsummer and will make a fair crop if planted as late as the first of August. The tubers are large and long in shape when fully developed. The skin is white with a distinct pink blush around the eyes.

It has become quite popular with the farmers on account of its wonderful vigor.

The stand secured is usually good even with ordinary cellar stored seed. It has been planted on the same soil for a good many years with no apparent deterioration.

It is not affected by blight and the vines continue to grow until frost destroys them. It cooks well, being creamy white and very mealy. There is, however, a certain bitterness of flavor, even after being thickly pared, such as is found in the skin. The tubers wanted for culinary purposes should be stored at once in a very dark place. If the skin becomes green by exposure to the light the acrid flavor is increased.

A few years ago a sport appeared which was quite similar to the original variety, but it is quite white all over with no trace of pink.

The white skinned variety is said to be somewhat better in flavor.

Of the other late varieties, Green Mountain, Peerless, Manistee, Carman No. 3 are all good. Green Mountain is probably the most

popular in this State. Peerless, however, is a good yielder and of good commercial shape and size.

The variety Prosperity yields well, but in some seasons the tubers are somewhat likely to grow rough and knobby.

EXPERIMENTS WITH TUBERS SHOWING WEAK SPROUTS VERSUS OTHERS SHOWING STRONG SPROUTS.*

It was noticed when planting the variety potatoes which were home grown and harvested in the summer, that many of the varieties had some tubers which were starting with very weak sprouts. It at first looked as though this might be due to absence of light, but upon further investigation, it was seen that this was not the case, for strong vigorous sprouts could be found under the same conditions as the weak ones. In fact both kinds could sometimes be found on the same potato.

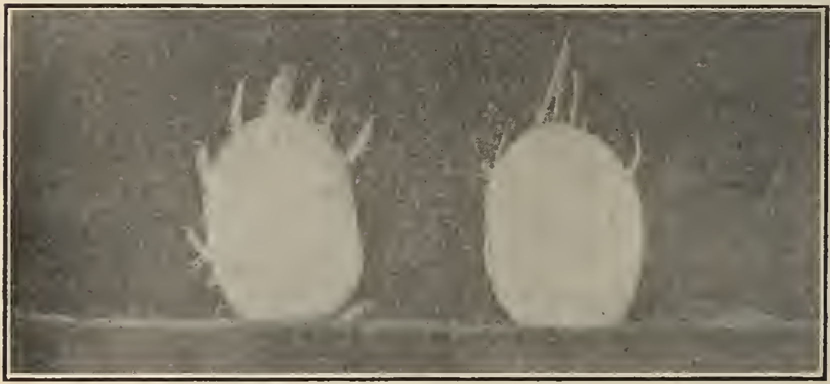


Fig. 1. Potatoes showing the characteristic "strong" and "weak" sprouts. Weak sprouts on the right.

It seemed as though this might be the cause for home grown seed not producing as well as the Maine seed, which always had strong sprouts. Some of the weak sprouted tubers were planted in a separate row alongside of the strong sprouted tubers from the same lot. The tops of the former were weak during the entire season, while the tops of the latter were strong. See figures 1, 2, 3 and 4.

The amount of the yields of the different varieties was in direct relation to the size of the tops.

*Subsequent pages are revised from Bulletin 132.

Fig. 2 Plants grown from strong and weak sprouts. Weak sprouts on the right.

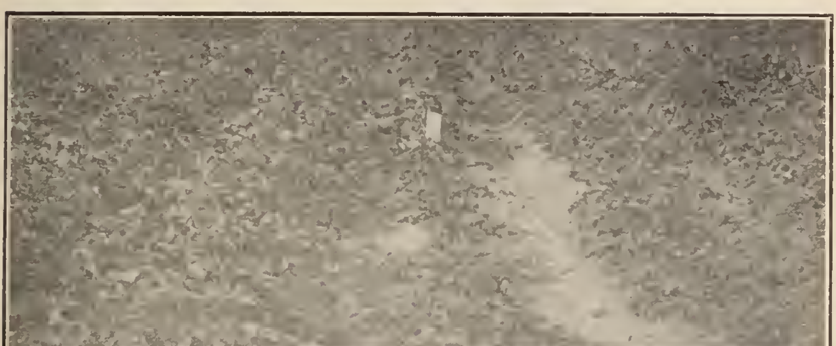


Fig. 3 Shows growth of vines from "strong" and "weak" sprout seed. Row marked with a white stake is from weak sprouts.

Fig. 4 Shows yield from strong and weak sprouts. Weak sprouts yield on the right.

CULTURAL DIRECTIONS.

Potatoes for the nearby market as well as for long distance shipping from the eastern shore to Philadelphia and New York, are considered quite a profitable crop in Maryland. These are mainly the early varieties, and the yield ranges all the way from eighty to three hundred and fifty bushels per acre. The farmers in the northern and western counties of the State grow a good many potatoes, but these are generally of later varieties. When an early crop is grown, it is usually planted as soon as the ground can be worked. The late crop is planted in some localities as late as August first.

Soil. A sandy loam well enriched is considered best for this crop. Vegetable matter is needed, but it should be in a thoroughly well rotted condition. Any vegetable matter in a state of decomposition, seems to foster the increase of the potato scab fungus.

Previous treatment of the soil. There is no doubt that the largest yields of potatoes are grown upon soils that have been annually manured for some years previous, and that have not been planted to exhausting crops like field corn.

It is good practice to plan a rotation and manure heavily the crop that precedes potatoes. Cabbage likes a liberal supply of manure, and as fresh manure seems to be suitable for this crop, it could be used freely for the cabbage and would then be well decayed for the potatoes which follow. The potatoes could be succeeded by grass and clover, or wheat with grass, which could be followed by cabbage again, and so on.

If a heavy sod is to be used for early potatoes, it should be plowed in the fall because if spring plowed it cannot be gotten into condition. A thin clover sod might be all right broken in the spring.

Manuring. If as stated above, potatoes follow some crop that has been well manured, commercial fertilizer is all that will be needed to get an early crop. A fertilizer with 7 to 9 per cent of phosphoric acid, 3 to 4 per cent of nitrogen, and 4 to 5 per cent of potash, will give good results.

A good formula for this is the following:

	Pounds
Dissolved Phosphate Rock	1000
Dried Blood	600
Nitrate of Soda	200
Sulphate of Potash	200

If wanted for a late crop the nitrogen need not be as readily available and the following formula may be used:

	Pounds
Dissolved Phosphate Rock	1000
Dried Blood	800
Sulphate of Potash	200

Either of these formulas should be applied broadcast at the rate of fifteen hundred pounds per acre, and be well mixed into the soil with harrow or cultivator.

If it is thought desirable to stimulate the growth of the young plants, one hundred pounds each of nitrate of soda and dissolved phosphate rock per acre, should be scattered in the row when the seed is planted. The potato, having to make its growth in such a short time, needs its food in a readily available condition. The formulas above provide for a generous amount of soluble phosphoric acid which is necessary to make the plant mature in a short time. Early maturity is very important, not only on account of being able to get the crop on the market as soon as possible, but also because some of the early varieties cannot withstand the moisture and heat of early summer, and if the vines are injured by tip burn, or blight of any kind, the tubers are sure to be undersized.

If it should ever be necessary to use fresh or partly decomposed stable manure for Irish potatoes, then dissolved phosphate rock should be used quite liberally with it. Eight to ten hundred pounds per acre would not be too much if stable manure had been liberally applied. Fresh manure is to be avoided, however, on account of its tendency for increasing the scab. Lime and wood ashes, while being excellent in general for most soils, should be used with caution for this crop, for the reason that the scab fungus seems to thrive in a neutral or slightly alkaline soil. The acid in the phosphate rock tends to keep the soil slightly acid, a condition favorable to the potato and unfavorable to the scab.

Preparation of the soil. The soil should also be thoroughly prepared mechanically. The plowing should be well and carefully done to the depth of eight inches. As a general thing not enough attention is paid to this matter of plowing. If the subsoil is clay, the drainage can be improved very much by plowing to a uniform depth with a large two-horse plow in the direction the land slopes. The bottom of the landslide of a large plow makes a runlet for the water. A wheel should be used to secure uniform depth. After plowing, the soil should be thoroughly pulverized by disc harrow or otherwise, to the depth of five inches.

Planting. Plant in furrows three to four inches deep made with

a plow. Cover by throwing two furrows on top of the seed. If a planting machine is used, set it to plant the same depth. This method of covering allows for two harrowings which mellow and level the soil before the growth appears.

Seed. The importance of good seed can scarcely be over-esti· estimated. For a good crop of early, uniform tubers, there must be a good start. According to experiments here it is necessary among other things, to start out with a good strong vigorous germ. A vigorous germ or eye can only be secured on some varieties by that germ being formed in a cool climate, or in the fall of the year when the weather is cool. For this reason, growers in the southern part of this State and in the potato growing section further south, should either secure their seed from a cooler locality or else replant tubers of the first crop and thus grow their own seed which is called "second crop" seed. The reason that growers in a hot climate felt the necessity of getting their seed from the North, or growing the "second crop," was somewhat obscure until the experiments at this Station during the past three years threw some light upon the matter.

These experiments showed the need for strong germs or eyes to secure a good crop. Evidently cool weather with a proper amount of moisture is what is needed to produce a strong germ. These conditions may generally be found in the lower sections of Maryland before the first of June or after the last of September. Eyes formed at that time will produce as good as northern grown seed.

Second Crop Seed. The seed called second crop is grown in the following manner: The small unsalable tubers of the June crop should be spread out thinly in a shady place. In two or three weeks they will have turned very green and the larger ones should be cut and the others have a piece taken from the side. It seems that mutilation has a tendency to hasten the development of sprouts. They should then be spread in the sun covering them thinly with earth or sand. After sprouting commences they should be planted in the ordinary way.

If favorable weather conditions prevail, a crop of tubers from the size of an egg to a marble will be harvested late in the fall. These will all make good seed with strong eyes or germs.

This will be thought by some growers to be too troublesome to practice, but for varieties like Early Rose, or any of the medium maturing varieties, it will be necessary to do this, or get seed from a cooler climate. If seed potatoes are large, they should be cut, for nothing is gained by planting large potatoes. Practically, if there are strong single stemmed plants one foot apart in the row, the largest amount of salable tubers will be produced. Theoretically, pieces of potatoes cut to one eye dropped at that distance would produce these results, but in experience, however, this has not proved to be so, for very often if weather conditions are not just right the small pieces of potatoes decay or dry up before the sprouts have attained sufficient strength to support themselves. To insure a good crop the safest plan is to cut the potatoes so that there will be at least two eyes upon each piece.

It will be found that if the pieces of the seed end and the pieces from the stem end are planted separately a more uniform stand will be insured. The eyes of the seed end sprout quicker than the eyes of the stem end and if they are separated it will be much better for cultivation and harvesting.

This separation of the eyes will not be necessary where second crop seed is being used as these usually start out with one strong germ from the seed end, and about all the cutting needed is to divide the larger tubers in half lengthwise. If home grown seed, aside from second crop, is to be used, it should have strong sprouts and be grown in cool weather.

Bud variation is quite common in plant life and potatoes sometimes vary in this way. It will, therefore, pay to go through the patch when the growth is about made or when the plants are in bloom, selecting and marking with a stake those which are most vigorous and healthy. These should be dug and stored separately from the general crop. If it is considered too troublesome to save enough to plant the entire crop this way, enough hills should be marked to produce several bushels. These may be planted separately and all the products be used for seed the following year.

Quantity of seed per acre. This will vary according to the size of the tubers. If large potatoes with few eyes are used, twelve to fifteen bushels are necessary, and if medium to small potatoes with plenty of eyes are planted, only eight to twelve bushels will be needed.

Cultivation. If the seed is covered with a plow the land will be left in a ridged condition. A week or two after planting, these ridges should be leveled down with a board or clod crusher. Just as the plants appear a smoothing harrow should be used to level the ground and kill the weeds. Very often, especially in late crops, it is not necessary to do any hand hoeing if this harrowing is thorough. Cultivation can be done with an ordinary five shoveled Iron Age or similar cultivator. Small shovels can be used the first time, stirring the soil deeply. At the last cultivation a broad shovel behind will work about the right amount of earth up to the hills.

Harvesting. As a general rule potatoes should not be dug until the vines mature and die, as the tubers will increase rapidly in size after the vines begin to turn yellow. After the vines are dead there is nothing gained by leaving the crop in the ground.

It is best not to dig if the sun is bright and the weather extremely hot for the tubers are easily scalded. The digging should be done in cloudy cool weather if possible.

There are several potato diggers on the market and where everything is in proper condition, with no rocks, weeds, or anything that will hang or clog, good work can be done with them. Many small growers, however, depend upon the plow and potato hook. A large one-horse, or small two-horse plow set at just the right depth to run beneath the potatoes without cutting them, will turn the hills bottom side up so the tubers may be easily removed with potato hooks.

The grading may as well be done in the field even though the crop

is not to be sold at once. The grades should be first, second and culls. Only the firsts should be shipped to distant markets, the seconds had better be disposed of near home. The culls can sometimes be sold to bakers who use them in connection with yeast in bread making.

When shipping to early markets, barrels or boxes must be used, as there is much less danger of bruising and heating than if placed in sacks. For the late crop, sacks are often used and are quite economical. One and one-half bushels are usually put into each sack.

Storing. Potatoes should be placed in the dark as soon as possible after digging. Light will turn the skins green and bitterness will extend into the flesh, making them very unpalatable. A temperature at or a few degrees below 40° F., will keep potatoes in good condition. Cellars under barns or dwellings or specially constructed vaults or caves, are often used. The storage place should be easy to ventilate, but need not be extremely dry. Storage in kilns or pits is often practiced, and where there is no frostproof building it is very cheap and convenient.

For a pit or kiln a high and well drained spot should be selected. Scrape away an inch or two of soil and cover with a layer of dry straw. The potatoes should be piled upon this, not more than ten bushels in the pile, and be covered with straw and one foot to fourteen inches of earth. Only sound potatoes should be stored in this way. If there is the least sign of rot the crop should either be sold at once or stored in boxes where they can be picked over occasionally.

Controlling Diseases and Insects.

Spraying to keep off diseases and insects must be considered as a very important part of potato culture. Experiments continued for several years have shown a marked profit when the crop, especially the late one, has been well sprayed.

For the insects and diseases affecting the tops Bordeaux mixture with either Paris Green or Arsenate of Lead is mostly used.

The spraying should be thoroughly done every ten days until the vines begin to mature. The late sprayings are very important to the fall crop. When the spraying is done mechanically the machine should, if necessary, be driven over the patch several times, or until all the foliage is protected with a coating of the material.

For diseases affecting the tubers endeavor to avoid infected land. If the seed shows any sign of scab soak the uncut tubers in a mixture of one-half pint of formalin and fifteen gallons of water for two hours. Do not apply lime, wood ashes or fresh manure to land that is to be planted immediately to potatoes.

To make Bordeaux Mixture dissolve five pounds of copper sulphate in twenty-five gallons of water, slake also five pounds of good stone lime in the same amount of water. Pour both together into the spray barrel. To this may be added eight ounces of Paris Green or three pounds of Arsenate of lead, which will kill the insects.

For more detailed directions for general spraying see Bulletin No. 143.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION

BULLETIN No. 173. JANUARY, 1913.

TOMATO VARIATIONS INDUCED BY CULTURE.

By Thos. H. White.

Introduction.

The common occurrence of variation in plants under culture would seem to indicate that some part or parts of the practice of that culture has a bearing upon this matter. The work reported herein was taken up with reference to three phases of this question, namely: pruning, feeding and temperature. It was thought that this would cover some of the most important conditions to which plants are subjected when brought under cultivation.

The phase of the work which had to do with the feeding with chemicals seemed to give such interesting results as to be worthy of publication at this time. The experiments relating to temperature have been continued through four generations. The pruning work was not carried further than the the first generation.

The Character of the Experiments.

1. A study of the effect of excessive amounts of Nitrogen, Phosphoric Acid and Potash, separately and in combination, on the variation of tomatoes and beans.
2. A study of the effect of temperature on Acme tomato variation.
3. A study of the effect of pruning on sweet peas and tomatoes.
4. A study of the effect of Dried Blood, Dissolved Phosphate Rock, Sulphate of Potash, separate and combined, on Red Cherry tomatoes, also effect of Iron filings on the same.
5. A study of the effect of cross-pollination upon well fed and starved plants.

History of Experiments.

The first of these were commenced in the fall of 1906. The plan was to treat soils with excessive amounts of Nitrogen, Phosphoric

acid and Potash, separate and in combination. Seeds were to be saved from all the fruits and all the plants on the several plots. From these a composite sample representing each plot would be drawn and sown for the next generation. Small individual variations that can be found in any variety of tomatoes were not to be considered.

Seven plots, each six square feet in size, were laid off on a green house bench and filled with rich soil. These were treated as follows:

		Applied at the rate per acre of
Plot 1:	Dried Blood	2000 lbs.
	Dissolved Phosphate Rock........	2000 lbs.
	Muriate of Potash...............	500 lbs.
Plot 2:	Dried Blood	2000 lbs.
Plot 3:	Dissolved Phosphate Rock........	2000 lbs.
Plot 4:	Raw Phosphate Rock.............	2000 lbs.
Plot 5:	Muriate of Potash...............	500 lbs.
Plot 6:	Sulphate of Potash...............	500 lbs.
Plot 7:	Nothing.	

Seeds of the Acme* variety of tomato were sown in the plots on October 2, 1906. These were thinned so that six plants were left standing on each plot. They were trained to a single stem and the flowers were self pollinated. The first lot of seeds from these were saved March 1, 1907. These were planted on another set of plots, prepared in the same way, out in the field, the first week in May, 1907. The soil of these plots was a heavy loam, quite fertile. Each plot contained four hundred square feet.

Some beans of the variety Wardwells Kidney Wax were also planted on these plots. The seed was sown in a row and the plants thinned to six inches apart; this left about eighty plants to the plot. The annual succession of these plantings has been uninterrupted since that time. The plots have also received their several kinds and amounts of fertilizers annually. The seed has been carefully saved from a number of different fruits and a composite sample of each taken and sown each time. The noticeable temporary effect of the fertilizers has been the same each year and is as follows: The plants growing on the complete fertilizers make a strong, vigorous growth. On the dried blood the same but with a decidedly darker color. The plants growing on the dissolved phosphate rock are usually an extremely light green in color, and the fruit ripens somewhat earlier There is never very much difference between the other plots, all being rather a light green in color. The fruit is all about the same. except that it is rounder and smoother on the dried blood plot, and

---

*The Acme tomato was chosen for this work because Dr. Chas. A. White of the Smithsonian Institute had published in Popular Science Monthly, June, 1905, a report of a peculiar variation. This variation was so different that it was considered a new variety. Dr. White named this variety the "Washington" and distributed seed. The variety as it developed here was very similar to, if not identical with, the Dwarf Champion.

apparently a trifle more irregular than normal on the potash plots. These differences, however, disappear when samples are planted on soil which has not been given any of the special treatments. Samples of seed of the sixth generation were planted in rows in the field under ordinary conditions and no extraordinary differences were noted.

By planting samples of seed this way in rows in the field it was thought that if there were any striking variations they would be easily detected, so far, however, none have been noted.

Experiment II—The Effect of Temperature on Tomato Variation.

In the fall of 1908 plots duplicating exactly those of Experiment I, were made up in a cool greenhouse. The heat radiating surface in this house was not more than sufficient to keep out frost in severe weather. The seeds taken from the stock of the out-door plants were sown and the plants thinned to twenty plants to the plot. The area of each of these plots was twenty square feet. They were made up on the ground, enclosed by cement walls one foot deep. Six inches of coal ashes was placed below for drainage. The top soil was a rich loam. The same temporary differences were noted regarding the color of the foliage as in the out-door plots. Also during the coldest weather the plants on plots 3, 4, 5, 6 and 7 would turn a deep bluish color. This would change, however, as the temperature rose and the days lengthened. As in the out-door work this succession has been continued without interruption for four generations. There have been no marked general variations. An exceptional variation, however, appeared on plot six the first generation after the plants were brought in from the outside. This, was one plant, which produced fruit of a scarlet color (Acme is purple). The seed of this plant, however, was not allowed to go into the stock to be saved, for unless all the plants on a plot varied in the same way it could not be considered the result of the treatment.

Seeds of this variation were planted and produced in the second generation some Acme among the progeny. This was undoubtedly an accidental cross.

The conditions in the greenhouse have not been exactly what was desired, however, in that the temperature was so low that there was no pollen ripened; in fact, the anthers were not normal, having a dried, twisted appearance. For this reason no fruit was secured during the coldest part of the season. Some of the plants will be grown in pots hereafter so that if necessary they can be placed in a slightly higher temperature to develop the pollen.

Experiment III—Effect of Pruning of Tomatoes and Sweet Peas.

Desiring to note the effect of pruning on the variation, some seeds of the tomato variety Red Cherry were sown. Several plants from these were set in a bed of good rich soil in the greenhouse. The

plants were supplied with an abundance of plant food and trained to a single stem. After four clusters of fruit had formed the tops were taken out so that all the energy of the plant could go into the four clusters of fruit. The leaves were also trimmed off one-half. The effect was very pronounced, and the plants grew extremely large. The foliage was very much increased in size and in some cases laterals started from the mid-ribs of the leaves. The fruit corresponded proportionately. Figure I is a photograph of two of the clusters of fruit. In the upper left-hand corner is seen a many-celled fruit that was very much increased above the size of a normal fruit of the same character. It can also be seen that nearly all the fruits have increased in size, and are somewhat flattened and irregular in shape. The normal size and shape of Red Cherry is like the three fruits near the stem, in the lower part of the plate.

Fig. 1.—Two clusters of fruit from pruned Red Cherry. Note the large many celled fruit in upper left-hand corner. Common Red Cherry is similar to the three fruits in lower center.

Seeds were saved from this many-celled fruit and planted in the greenhouse. Part of them in a warm house and part in a cooler one. Eighty plants in all were grown from these seeds. Sixty-three of these plants showed a few fruits of the many-celled type. None, however, were out of the ordinary for size. Sometimes two or three but usually only one to each plant. This fruit would often be the first fruit on the first cluster, but not invariably, as sometimes three or four clusters would be set before the many-celled type showed. The other seventeen plants gave all round fruits. In other work with Red Cherry there has been noticed fruits of the many-celled type, so it may be considered that a percentage of many-celled fruit is normal with this variety. In the work with sweet peas several plants of the variety Christmas Pink were pruned to a single stem. After several pods had set the terminal shoot was cut off just above the pods. The laterals also were kept from growing. The effect of this was an increase in the size of the pods and seed, also the foliage. At the same time the foliage took on a very dark green color. Fifty seeds were saved and were planted the following year. All the plants growing from these seed produced normal blossoms.

As the pruning work did not seem to have any effect on the succeeding generation of the plants worked with, it was not continued further.

Experiment IV—The Effect of Dried Blood, Dissolved Phosphate Rock and Sulphate of Potash Separate and Combined on Red Cherry Tomato.

After working two seasons with the Acme tomatoes and Wardwell Kidney wax bean on beds of soil where there was nothing to check leaching, it was thought more positive results might be obtained by growing plants in pots where greater control could be maintained.

Seeds of the Red Cherry tomato were obtained from W. Atlee Burpee & Co., and a new series were started in pots. In addition to the fertilizers another pot was added to which iron filings were applied. The amounts of fertilizers applied were approximately the same as in the out-door plots for the Acme tomato and Wax beans. The amounts were not strictly adhered to, however, as consideration of the health of the plants had to be taken into account. The aim was to give the plants just as much as they could stand. It was found that this would vary acccording to the time of year and temperature. The plants would remain healthy and thrive on an amount of fertilizer in cool weather that would sicken and kill them in hot weather. Ordinary six-inch flower pots were used. These were filled with potting soil and the amounts and kinds of fertilizer, as stated for Experiment I, were mixed with it. For the pot of iron filings about one-fifth of the bulk of the pot of soil was used. The iron filings were borings and chips from the machine shop. The pots when filled were set in saucers in the greenhouse. Thirty to forty seeds were sown in each pot. These were carefully thinned down until

only one was left in each pot. As the pots became filled with roots and grew down into the saucers more fertilizers were applied, both on the surface of the soil and among the roots in the saucers.

The growth of these plants was quite similar to those of the outside plots, only a good deal more pronounced.

The plants grown in the soil treated with iron filings were dwarfer than the others with very dark green foliage and purplish stems.

After the plants had grown for six months and several fruit clusters had set the fruit was gathered and the seed saved. The seeds and pulp were pressed out into small bottles and allowed to ferment for forty-eight hours. They were then dried in wire sieves. The pots were also allowed to dry out thoroughly after which the old plants were shaken out of the soil. The soil was then dumped from each pot and after having another portion of fertilizer mixed with it was put back into the pot from which it was removed. The seeds were again sown in their respective pots and the treatment continued.

After four generations had been grown in this way some of the surplus seed was sown under normal conditions in a greenhouse bed. As soon as the plants were up it was at once remarked how dark green and vigorous looking were the plants from the Dried Blood treatment. Those from the Iron filings also showed a change, in that they were somewhat stunted and of a dark green color with a great deal of purple color in the stems.

Those from the Dissolved Phosphate Rock and Sulphate of Potash were very much lighter green. This method of treating the plants was continued without interruption, the same soil and same pots being used, until the sixth generation. In order to see if the changes were becoming permanent some seed of the fifth generation were taken and sown in good soil under normal conditions. The same differences in character were observed. Also that the plants grown from the seed of the pot receiving dried blood were not only darker green but had increased strikingly in vigor and size of fruit. Three generations of these were grown under normal conditions, without any applications of fertilizers and the third generation which are now several inches high show the same differences.

In samples of the sixth generation, of the original series under the fertilizer influence, some startling differences appeared. They were from the plants that had received the dried blood. Figure 2 shows one of these. Until the time that the plants were about to show the first cluster of blooms the seedlings appeared to be alike; but at this period of their growth instead of producing a cluster of six to eight flowers there was only one and this appeared to be united with the leading shoot. This resulted in the production of a single blossom setting in a calyx of which the sepals were very abnormal, having the appearance of small leaves. The ovary was somewhat flattened and distorted. The pistils and anthers seemed to be normal, only somewhat twisted and shrunken. Only one of these flowers was successfully pollinated. This produced two seeds, one of which has been grown into a plant that has grown well and produced fruit in the normal condition.

Fig. 2.—Shows a plant of sixtn generation Red Cherry treated with Dried Blood, having the peculiarly united flower cluster and terminal shoot.

After noticing this peculiarity, more of the same seed was sown so that an accurate count could be made of the seedlings having the abnormal growth. In an examination of two hundred and fifty there were found twenty plants with this abnormality; this equals eight per cent.

Desiring to more clearly note the differences between the plants growing on the different fertilizers a sample from the dried blood, complete fertilizer, and dissolved phosphate rock were set in a greenhouse bed and trained to single stem. A photograph of these plants is shown by Figure 3.

Fig. 3.—Shows plants of Red Cherry grown off Dried Blood (left); Dissolved Phosphate rock (center); Complete fertilizer (right.

While this work had been carefully conducted and enough seed sown each time, so that by thinning them the chance of error from individuality would not be serious, it was thought that a check on this would be valuable. Therefore, seeds of the second generation which had been preserved, were sown in a flat box of soil. Some seed of the sixth generation was also sown in the same way. After the plants were of a size to transplant they were set outside in the garden all under exactly the same conditions as nearly as possible. The growth they have made is shown by photograph Fig. 4. Between the two stakes to the right can be seen the plants of the sixth generation and on the left those of the second. As these seeds all came from the same parent originally, the difference can be fairly attributed to the influence of the different fertilizers.

Fig. 4.—Shows Red Cherry tomato growing outside. Second generation on the left of center stake and sixth generation on right. Note the increased vigor of plant on extreme right. This is from Dried Blood treatment. The fourth plant from left is from same parents but is of the second generation.

The plant on the extreme right is the one from the dried blood treatment in the sixth generation. The plant corresponding to this from the second generation is the fourth from the extreme left. It is unfortunate that several of the plants set in this row were destroyed. As it is believed that it would also show that there is a

stunting of the growth in the case of the treatment by dissolved phosphate rock. This, in fact, was very marked in the plants grown in greenhouse. (See photograph on Page 129.) The plant from the dissolved phosphate rock was set at extreme right. Unfortunately this was destroyed by a cut worm.

Measurements of these plants show that the plants of the sixth generation grown under the influence of the dried blood are one-third larger in height, length of leaf and size of fruit, than those of the second. (See Fig. 5). The fruit also is improved in quality and flavor. There is more fibre in the pulp and less acid to the taste in the juice of the improved fruit than in the earlier generations.

Fig. 5.—Leaf and cluster of fruit of Red Cherry of the second generation (left); same of the sixth generation (right).

In his book on "Tomato Culture," page 7, Will. W. Tracy says: "I have given a true stock of Cherry most careful cultivation on the best of soil for twenty consecutive generations without any increase in size or change of character in fruit."

Experiment V—Cross Pollination of Well-Fed and Starved Plants.

The two varieties of tomatoes, Red Cherry and Yellow Plum, were used in this work. One pair of parents were well-fed and the other pair starved. The pair that were starved were grown in pots in rather poor soil, and nothing but water supplied to them. The other, the well-fed pair, were set in a rich bed of soil in the greenhouse and were watered and fed all they would stand. The resultant growth was commensurate with the treatment. The well-fed parents grew very luxuriantly; so much so that one of the fruits of the yellow plum took on a flattened and ridged appearance. Reciprocal crosses were made, that is, the well-fed Cherry was crossed by Yellow Plum and vice versa. The same thing was done with the two starved parents.

Two hundred plants were grown from the seed saved from these crosses. These were to all appearance practically Red Cherry in the color of fruit. The shape was generally Red Cherry but some had the shape of the Yellow Plum. The stem and leaves seemed to have more of the characteristics of the Yellow Plum. Eighty plants from seed of this, F. 1 generation, were grown to maturity. These broke up, in the F. 2 generation, in the following order:

	Red Cherry X Yellow Plum—Starved.	*Red Cherry X Yellow Plum—Well-Fed.*
Red Cherry	8	15
Yellow Cherry	5	0
Red Plum	3	0
Yellow Plum	4	0
Other forms	0	0

	Yellow Plum X Red Cherry—Starved.	*Yellow Plum X Red Cherry—Well-Fed.*
Red Cherry	12	13
Yellow Cherry	4	9
Red Plum	2	2
Yellow Plum	1	1
Other forms	0	1

As will be noticed from the table the color and shape characters combined about as would be expected, and the treatment had no appreciable effect on the progeny.

Seed was saved from the plant bearing fruit listed as "other forms." These were planted and have fruited. They have broken up in such a way as to show there was accidental pollination with some Acme planted in the same field.

Conclusions.

From the work done it would appear that only one of the treatments, that of the fertilizers on Red Cherry tomato, made any permanent changes in the character of the plants worked with. There can be no doubt, however, that in the case of Red Cherry, treated with Dried Blood, there is permanent variation to the third generation.

Mutilation as in the pruning, also starvation and high feeding, as in the well-fed versus starved, do not seem to have had any permanent effect. In following this work it is evident that there is better control of conditions when plants are grown in pots. In the out-door work where rainfall is variable, control is difficult.

THE MARYLAND AGRICULTURAL
EXPERIMENT STATION

BULLETIN No. 174. FEBRUARY, 1913

HOG CHOLERA.

By B. M. Bolton.

Introduction.

Hog cholera has presented one of the most difficult problems to the investigator in all the range of human or of veterinary medicine. Not only the observation of the clinical features, but the results of the most careful bacteriological examinations all lead to false conclusions in regard to the nature of the disease and its cause. The very name itself shows that the character of the disease was totally misunderstood at the start; for the disease is not cholera at all as we understand cholera in human beings. It much more nearly resembles typhoid fever in the human subject than it does cholera, and in fact the term "pig typhoid" has been employed by some writers for the disease. But the name hog cholera, however inappropriate, has now become so firmly fixed in the spoken as well as in the written language, that at present it could hardly be changed without the danger of leading to confusion.

When the disease was first noticed and described there was little agreement among medical men and veterinarians as to the cause, the means of dissemination, or as to whether there were not several different diseases included under the one term, hog cholera, as claimed by some or whether there was one disease with different manifestations, as claimed by others, and the results of the earlier investigations of the disease by the modern methods of bacteriological research, conducted by the most competent authorities were conflicting.

This lack of harmony in the results of investigation led to a heated controversy between the authorities in the United States Agricultural Department and certain other investigators, and the Hon. Norman J. Coleman, at that time Commissioner of Agriculture, appointed a commission of disinterested persons to enquire into the merits of the case. As a member of this commission I had the opportunity of studying the disease in various parts of the country; as far North as Philadelphia, as far West as Nebraska, and as far South as South Carolina. At a later period I assisted Dr. Dorset and Dr. McBryde in the investiga-

tion which led to the establishment of the fact, already sulmised and even to some extent proven by Dorset, that the disease is caused by a virus hitherto not recognized, contained in the blood and other fluids of the body, and which cannot be isolated by the usual methods of examination.

History.

The history of hog cholera must of necessity be obscure for the work just refered to defined the disease sharply for the first time, and it is highly probable that previous to this work various diseases of hogs presenting some of the symptoms of hog cholera were erroneously called by this name. On the other hand it is equally possible that there were cases of hog cholera which were mistaken for other diseases. In the Fourth and Fifth Annual Reports of the Bureau of Animal Industry for the years 1887 and 1888 the following history of the disease in America is given.

"The first outbreak of the disease supposed to be hog cholera that is referred to occurred in Ohio in 1833. It was reported from one county in South Carolina in 1837 and from one in Georgia as having existed in 1838. It existed in 1840 in one county in Alabama, one in Florida, one in Illinois and one in Indiana. In 1843 it is reported from one county in North Carolina. In 1844 one county of New York reports being affected. Its presence in 1845 is only mentioned by one correspondent from Kentucky.

"The thirteen years, from 1833 to 1845, inclusive, form a period of years in which but ten swine diseases, supposed by the writers to have been hog cholera, were mentioned in these replies. It is evident that during this period hogs were generally healthy throughout the country and that the losses from disease were not sufficient to attract much attention. The nature of the disease referred to as existing so long ago, may, of course, be questioned at this day, and we have no means of deciding whether or not any particular outbreak was cholera or some non-contagious malady due to local conditions. It is reasonable to conclude, however, that the correspondents [from whom this information was gathered] were correct in their opinion in most cases, because, since 1845, the outbreaks mentioned became more numerous year by year until we find nearly the whole country involved. This rapid increase of the number of affected sections would seem to indicate that a contagious disease had been introduced and carried to widely separated sections of the country from which it extended until, with a year favorable to its propagation, we find a sudden and alarming increase.

"Whether the outbreak which occurred in Ohio in 1833 was the first introduction of hog cholera in this country or not cannot now be determined. It seems reasonably certain, however, that the contagion was imported from Europe with some of the animals that were brought from there to improve our breeds of swine......Having once been introduced it spread gradually, following the lines of commerce and

being a long time confined to them, until extending step by step, it has at one time or another invaded every section of the country in which swine raising is a prominent industry."

The history of hog cholera in Maryland as stated in substance in the report of the Bureau of Animal Industry, above cited, is as follows:

Anne Arundel.—Hog cholera was prevalent in this county for a number of years previous to 1887.

Baltimore.—Hog cholera existed in this county in 1865. In 1866 it was quite prevalent, and in every case broke out first among the hogs that were running at large or in grass or stubble fields.

Frederick.—Hog cholera prevailed in this county in the latter part of the summer, 1887, and swept off large numbers of hogs.

Garrett.—About 25 per cent. of the hogs in this county died of hog cholera in 1887. Nothing was heard of the disease in this county until 5 years before 1887.

Somerset.—Some 30 years previous to 1887 a disease closely resembling hog cholera if not identical with it prevailed to some extent in this county, but the disease prevalent at that time was not so general nor so fatal except to very young hogs as it afterwards became. For a few years previous to 1887 the disease became so prevalent and fatal that the pork production of the county fell below the consumption, so that pork had to be imported.

Queen Anne's.—There was a time for the three years previous to 1887 that the disease did not prevail in this county.

Talbot.—Hog cholera prevailed in a mild form for several years around 1887 previous to 1886, but it became very virulent at that time. Hogs that had access to stagnant pools were the first to become infected. Even sucking pigs were affected. A description given of a hog examined by autopsy leaves little doubt that the disease of the hog was that which we call hog cholera.

Wicomico.—Hog cholera first appeared in this part of Maryland in 1864, when Wicomico was included in Somerset and Worcester. After this date hog cholera occurred several years, the most severe epidemic occurred in 1873 when it carried off some 3,000 head. In 1884 it was mostly the fat hogs which were affected, those kept up in the sty being the greatest sufferers. It is estimated that some 2,500 hogs died that year. In 1844 a great many hogs died in the region now included in Wicomico, but it is not known whether the deaths were due to hog cholera or not.

Worcester.—While the disease was not general in this county during 1887, some sections of the county suffered heavily.

Although hog cholera is not the only disease to which hogs are subject, nevertheless it is the most important one excepting only tuberculosis. In the Bureau of Animal Industry Report for 1909 it is stated that there were 45,133 hogs in all condemned at the slaughter houses under Government inspection during the year; of these, 20,789 were condemned for hog cholera. According to the same report there is no disease which any where nearly approaches tuberculosis or hog cholera in the number of cases. Hog cholera alone was responsible

for about as many condemnations as all of the other diseases combined except tuberculosis. The Bureau of Animal Industry Report for 1910, the last report published to date, 52,429 hogs condemned for all causes at inspected slaughter houses for the year, and of these 7,677 were condemned for hog cholera. It may be that the smaller number of hogs condemned for hog cholera 1910 as compared with the number condemned for the same cause in 1909 may be accounted for by the use of the anti-hog-cholera serum during the later period. If it were found upon investigation that this were the case it would be important evidence of the efficacy of the serum treatment.

The Nature of the Disease.

The disease which is now known as hog cholera is an infectious disease of the blood, and as has been stated in the introduction it is not cholera at all as we understand this disease in the human being. Cholera in human beings is a disease caused by a spirillum or vibrio which is introduced into the stomach with the food or water, and causes "rice-water" stools, extreme prostration, cramps in the calves of the legs, and collapse. Hog cholera germs on the other hand get into the blood in some way not yet determined, and aside from a diarrhoea which is usually present there is but little similarity with the other symptoms of cholera. Even the diarrhoea in hog cholera does not resemble the rice-water evacuations of cholera in the human subject. The lesions found at autopsy on hogs that have hog cholera do not at all resemble the lesions of cholera in human beings.

It is customary to speak of the germs of hog cholera, and it is perfectly justifiable to do so although the germ has not been seen nor isolated. Since the disease is transmitted from one hog to another by association, and since the various body fluids of the hog sick with the disease produce the disease in well hogs when these are inoculated with them. According to our present knowledge no disease can be transmitted in these ways unless it is caused by a living germ. The germ of hog cholera, however, has strictly speaking not yet been discovered though we know that it must be contained in the various body fluids. It cannot be seen even with very high powers of the microscope, yet it must multiply in the hog's blood and in other fluids of the hog's body. Moreover, the virulent blood of a hog-cholera hog may be filtered through the fine pores of a porcelain filter and still not lose its virulence, showing that the germ must be infinitesimally small. It is customary to speak of the disease-producing cause of hog cholera as a filterable virus, and the germ is also spoken of appropriately as an invisible microbe.

While this filterable virus or invisible microbe is capable under laboratory conditions of producing hog cholera, nevertheless, in the disease as we find it in spontaneous outbreaks in the field, on the farm, the invisible germ is rarely if ever the only microorganism concerned. Certainly, in the ordinary outbreak at least it is always a complex of diseases. The hog becomes infected with the filterable virus which

quickly renders the animal susceptible to invasion by other pathogenic organisms.

The secondary invaders are not always of one species, it is true, but according to my experience the *B. cholerae suis* is that most fre-frequently found, and *B. pyocyaneus* next in frequency. Now these organisms as well as others found associated with the filterable virus are capable of producing disease and death by themselves. Since this is the case it would be irrational to think that these bacteria could be present in such large numbers as they often are in hog cholera without causing pathological lesions of themselves, or intensifying the lesions caused by the filterable virus. It is not at all probable that they are inert, but on the contrary it is far more likely that they very seriously affect the course of the disease, or at times even entirely mask and obscure the features of the disease due to the filterable virus. In fact the question suggests itself whether it would not be advantageous to immunize hogs against the most common of the secondary invaders in addition to using the anti-hog-cholera serum to be described below. It is quite possible to assume that the anti-hog-cholera serum in some cases protects the hog from the filterable virus, but that this virus may have already opened the portals to infection with the secondary invaders before the animal was inoculated. It is not improbable at least that the anti-hog-cholera serum is capable of heading off the disease produced by the filterable virus in a hog even after the animal becomes infected in the very beginning, but that the secondary invaders may have already found entrance. The anti-hog-cholera serum protects against the filterable virus alone, not against disease produced by any other germ.

The disease is very highly infectious. After it once gains entrance into a herd, very few if any escape becoming infected, though all may not die. For the outbreaks are not of equal virulence; in some of them all or nearly all of the hogs that are attacked die of the disease, while in others comparatively few of the hogs die, although all may become sick. There is also a difference in the length of time hogs linger with the disease, in some outbreaks the disease is very rapid in developing and runs a very acute course, the animals dying in a few days after they become sick. In other outbreaks the disease runs a chronic course, hogs remaining sick for many weeks, and finally recovering. Even in the acute outbreaks some of the individuals may show this chronic form of the disease. But in these chronic cases where recovery does finally occur the animals are never thrifty. If they were young when they were affected they remain stunted, if they were full grown when attacked they never fatten properly.

It should be borne in mind that hog cholera is a specific disease, not merely a diarrhoea in hogs. Hogs may have diarrhoea from various causes, such as indigestible food, but such an animal is not dangerous to other animals; but the hog that is suffering from hog cholera is quite sure to transfer the disease to other hogs whether it is suffering from diarrhoea or not.

The name hog cholera is now no longer employed loosely to desig-

nate any or every disease of hogs accompanied with diarrhoea. It must be restricted to the specific disease.

Just how the filterable germ enters the body in the first place, and how the secondary infection with the associated pathogenic bacteria takes place are at present not known and can be only conjectured. It may be that the infection takes place through the feed and drink, or it may be that the germ gets into the body of the hogs through the bites of insects; blood-sucking flies, mosquitoes, fleas, lice; or it may be by both of these means. But by whatever means the contagion is carried, and whatever the portal of entry into the hog, the filterable virus after it once finds its way into the body of the hog spreads through the blood and the lymphatics to all parts, not only causing certain lesions itself, but opening the road for infection by other disease producing germs.

The filterable germ is given off from the body of the sick hog in several different ways. It has been proven that the urine of a hog suffering from hog cholera will cause the disease in well hogs by subcutaneous injection, in the same way it has been shown that the secretion from the eyes of a hog-cholera hog will cause the disease in well hogs on injection. The germ is also probably thrown off in the feces and in the phlegm coughed up by the sick hogs.

Contributing Causes.

It is customary to speak of bad sanitary conditions as contributing causes, but it is doubtful whether these have any direct effect in causing the disease. At least it is true that hogs that are well fed and housed and otherwise kept under good conditions generally are just as apt to be attacked in times of epizootic as those kept under less favorable conditions. Until the means of spread and portal of entry are more definitely known it is idle to talk about contributing causes. Proper sanitary conditions are of course good for the general health and thrift of the hog just as well as for other animals, but, as in typhoid fever in human beings, the strong, healthy individuals seem to be just as liable to infection as the weak and least robust. At least it is true that in all experiments made by injecting hogs with disease blood the healthy, vigorous animals become sick with the disease as promptly as those that are less vigorous. The course of the disease in vigorous hogs seems also to be the same as in the unthrifty. The previous health of the animal does not influence the length of time the hog affected lives nor its ultimate recovery or death. Some of the unthrifty hogs will often survive in an outbreak in a herd, while some of the stronger animals succumb. There seems to be no law in regard to the matter, thrifty and unthrifty seem equally susceptible to infection, and, equally likely to die or get well.

Symptoms.

The symptoms of the disease are not always very marked, and they vary in intensity in different outbreaks and even in different cases.

One set of symptoms may be pronounced in one set of cases while in another set of cases another set of symptoms may predominate.

The signs shown by the animal in the early stages are dullness and apathy, and where several hogs are affected at the same time they are apt to lie huddled together. The eyes are dull and droopy, with abundant watery secretion from them which afterwards dries up and glues the lids together. The animal becomes very sluggish, and finally staggers about if compelled to move. The hind quarters are particularly affected by this tottering gait. The flanks and abdomen are drawn in, and back roached up. The respiration is quick and shallow. There is often complete loss of appetite accompanied with thirst due to fever. Except in very acute, rapidly fatal cases there is emaciation. Coughing and vomiting are often to be noticed. Sooner or later red spots, due to hemorrhages in the epidermis appear on various parts of the body. These spots are usually more or less circular in outline, though they may be more diffuse and spread irregularly over the surface. They are apt to appear first back of the ears, but they may be found sometimes also inside of the thighs and over the abdomen, or in fact over the entire body. Fever is always present, the temperature ranging from 104° F. to much higher than this. At the start there is constipation, but later the evacuations from the bowels are apt to be frequent, thin and streaked with blood, and they are accompanied by more or less tenesmus or straining. In some cases this symptom is less pronounced than in others or it may be lacking altogether.

Post Mortem Appearances.

At autopsy the animal is found to be poorly nourished, though sometimes in acute cases it is fairly well nourished, the disease not having lasted long enough to cause emaciation. The skin behind the ears, inside the thighs, over the abdomen, and perhaps all over the body either sprinkled more or less thickly with punctiform hemorrhages; or showing more diffuse, irregular hemorrhagic infiltration of the epidermis. On cutting through the skin, the sub-cutaneous fat may be found fairly well preserved, though it is usually scanty, and never abundant. The fat may show small petechial hemorrhages scattered through it. The lymph glands at the angles of the jaws are always congested or even hemorrhagic as is seen by their dark red or purple color on section. The inguinal lymph glands, and in fact the lymph glands throughout the body are usually congested or hemorrhagic. The lungs are usually inflated, and show very characteristic mottling due to hemorrhagic infarction of some of the lobules. This gives to the lungs more or less roughly the appearance of a checker-board, somewhat irregularly rectangular areas interspersed with rectangular pale pink areas.

The extent of this checker-board mottling varies in different cases. Sometimes there are large areas of this hepatization as the purple areas are called, and even the whole lobe of a lung may be found hepatized.

The pleurae are covered with fibro-purulent exudate and are more or less adherent to the wall of the thorax and to the lungs showing

that there existed pleurisy with effusion, and organization of the exudate.

The pericardium or heart-sac is covered with a fibrinous exudate which sometimes makes it adherent to the surrounding lung tissue, and sometimes to the heart. The pericardial sac is filled with exudate, and may show petechial hemorrhages in the parieties.

The heart often shows punciform ecchimoses in the walls. The interior of the heart is usually free from lesions, the valves intact.

The diaphragm is sometimes glued to the lungs by a fibrinous exudate.

The serous or external coat of the stomach may show punctiform ecchimoses. The mucosa or inner coat of the stomach usually shows more or less of the punctiform ecchimoses in the cardiac fundus, that is the left lower portion. The peritoneum usually shows punctiform ecchimoses. The stomach is usually empty, but it may contain some partly digested food. The pylorus is usually intact.

The mucosa or inner lining of the small intestine is usually smooth and normal, the Pyer's plaques distinct.

The large intestine is nearly always ulcerated, and the ulcers may be separate or they may be confluent, or there may be large irregular ulcerated areas. The isolated ulcers usually have a quite characteristic appearance which has led to their being called "buttons." These buttons are raised above the surrounding tissue of the mucous membrane, and they are more or less irregularly circular. They are usually covered by a black, coarsely granular material somewhat resembling coffee grounds. The ulcers are also often pigmented with a yellow substance. The ileo-cecal valve, the valve between the small and the large intestine, is nearly always the seat of a hog cholera button ulcer.

The rectum may also be the seat of these ulcers.

The liver usually shows petechial hemorrhages or even large hemorrhagic infarcts and even areas of necrosis.

The spleen is greatly swollen, often extending beyond the median line to the right. It shows larger and smaller hemorrhagic areas, infarcts, or punctiform ecchimoses.

The kidneys show one of the most characteristic features of the disease, and that is the speckled egg appearance due to the punctiform ecchimoses which are nearly always present. These ecchimoses are seen as soon as the capsule, the outer covering of the kidney, is removed. On cutting open the kidney these hemorrhages can be seen mainly in the cortex or outer portion.

The mucous membrane of the bladder is usually speckled over with punctiform hemorrhages particularly in the trigonum region.

Some of the symptoms described above and some of the pathological lesions may be not very plain in all hogs that have hog cholera, and some of them may indeed be lacking altogether, but they will be noticed, one or other or all of them in the various hogs in an epizootic. The farmer should familiarize himself with these symptoms and lesions so that he will be able to recognize the first case that makes its appearance in a herd of his own or on a neighboring place.

The sooner the disease is recognized, the better the chance by the prompt use of the anti-hog-cholera serum of keeping it from spreading to the rest of the herd.

Differential Diagnosis.

It is not likely that hog cholera will be mistaken for any other disease, but some points of similarity exist between it and some other diseases to which hogs are more or less subject.

There is a disease supposed to be due to improper methods of feeding, an exclusively corn ration or the feeding of spoiled corn, which causes staggering gate in the hind quarters. This is known as hemiplegia in hogs, but it is not accompanied by fever, and is not infectious, the animals affected with it do not have a cough nor running at the eyes, or the red spots on the skin.

Tuberculosis presents some of the features of hog cholera, or rather it may present points of similarity to the chronic form of hog cholera. But the lack of the red spots on the skin in tuberculosis, and the fact that in tuberculosis the hogs do not stagger in their hind quarters usually make it easily possible to differentiate it from hog cholera. At autopsy tuberculosis sometimes shows more or less similar lesions to hog cholera, even to ulcers in the intestines. But the hemorrhagic lesions always so marked in hog cholera on the one hand, and the characteristic tubercle of tuberculosis on the other will serve to establish a diagnosis at least for any competent veterinarian or physician. Any intelligent person, however, who has seen cases of the disease is not apt to mistake it for tuberculosis or anything else, for that matter.

Veranus A. Moore, of Cornell, has reported the accidental poisoning of a herd of swine with soapy water which produced symptoms similar in some respects to those of hog cholera.

It will scarcely at this day arouse any controversy to say that the disease which Theobald Smith once named "swine plague" is very probably nothing more than a form of hog cholera which manifests itself more by the changes produced in the lungs than by those produced in the intestines. The possibility of course suggests itself in this connection that Smith's swine plague bacillus as a secondary invader while not the cause, is more or less frequently an adjuvant to the filterable virus in the production of the lesions found in the lungs of the hogs in which the organism is found.

General Sanitary Measures.

It follows from what has been said above that the farmer cannot depend upon general sanitary measures to ward off hog cholera nor to cure his hogs if the disease attacks his herd. The disease is a strictly specific one, and unless the specific germ is present the animal will not take the disease no matter how unwholesome the surroundings; on the other hand healthy, sound hogs will take the disease if the germ is present no matter how sanitary the surroundings are.

Every one knows, or should know, that hogs and in fact all farm animals ought to be kept under wholesome conditions, but it is not probable that general hygienic measures afford any special safeguard against this disease.

Quarantine measures may be of some value in so far as these are practicable, but even such measures are of limited value only, since it is not known what to guard against. If it were known that the disease is spread by flies, measures might be taken to guard against flies, or, generally speaking, if the mode of spread were known, then it would be possible to resort to intelligent quarantine measures; but as long as this is not the case, we are working more or less in the dark. Still it is to be recommended that there should be as little communication as possible between any place where hog cholera is known to exist and all neighboring places.

Other special measures would also be possible if it were only known definitely how the germ gets into the hog, whether through the food or drink or whether it is through insect bites. It would seem that it takes place through insect bites more usually than it does through food, if it does not take place exclusively in this way. The fact that injecting the disease blood under the skin produces the disease much more readily than feeding the hogs on it, leads to this conclusion. If this is true it points to the employment of some means to protect the hogs in some way from biting insects during the insect season. The disease is most prevalent during such seasons.

There can be no question, but that the disposal of the carcasses of all hogs that have died of hog cholera is a most important matter. Every hog cholera carcass should be burned or deeply buried, and in the latter case the carcass should be thickly covered with quick lime before the dirt is shoveled in the pit. But burning is the most efficacious and is easy to do. There is quite good reason to believe that buzzards are carriers of hog cholera contagion and doubtless prowling dogs carry it.

Prevention by Inoculation.

General quarantine measures, prevention of insect bites and burying or burning the carcasses of hog-cholera hogs all put together are not nearly so efficacious as preventives of the disease as the inoculation of well hogs with the anti-hog-cholera serum as first recommended by Dorset, and as proven by the tests of Dorset, McBryde and Niles to be thoroughly efficacious. These tests have been repeated by many others, and the evidence of the value of the serum in preventing the disease in well hogs is very convincing, and is constantly accumulating from practical experience. This method has saved thousands of hogs not only in this country, but also in other countries. It does not cure the disease after the hog has become sick, but it protects the animal with almost absolute certainty, it is consequently the best possible means of prevention. A hog that has received a sufficient does of the serum may be exposed in every possible way with perfect impunity. Such a

hog remains well when other hogs are dying all about it in the same pen. So it can be stated with great certainty that if the serum has been inoculated into the hogs before they have become infected, and if a sufficient dose has been administered the disease will not attack the herd. By the use of the serum whole herds have been prevented from taking hog cholera while other hogs in the neighborhood were dying on all sides.

One of the most striking proofs of the efficacy of the serum in preventing hog cholera was afforded by tests which were conducted under the auspices of the Nebraska Swine Breeders' Association and other large swine breeders at the South Omaha Stock Yards. The serum was administered in these tests by Dr. W. B. Niles of the U. S. Dept. of Agriculture, in the presence of representatives of the press and of the Swine Breeders' Association. The methods employed in the tests and the results obtained are given in a pamphlet published by the Union Stock Yards Company, Omaha, Nebraska, from which the following extracts are taken:

"Thirty Chester White shoats, weighing 40 to 50 pounds, were purchased by the Stock Yards Company from Mr. Jacob Armbrust at his farm west of Omaha, after having been selected by Government representatives with special care to see that there had been no recent cases of cholera in the herd. Mr. Armbrust stated that there had been no cholera among his herd during the past three years.

"July 23rd, four of these shoats were brought to the Stock Yards, where they were placed in an isolated pen and inoculated with blood drawn from a hog which was known to be sick from hog cholera. Post mortem examination revealed lesions of the disease in the animal. The four shoats after inoculation were marked by placing a ring through the left ear of each and then placed in a pen together.

"On July 28th, when two of the four inoculated animals showed, by rising temperature and other unmistakable symptoms, that they were clearly stricken with cholera, the remaining 26 pigs were brought in from Mr. Armbrust's farm. Eight of these were tagged by rings in their right ears and without treatment or inoculation of any kind were released in the enclosure with the original four infected ones. The balance of the animals, eighteen in number, were treated with the protective serum and immediately turned into the pen with the four infected shoats and the eight which were unprotected to await the development of the disease.

"In the course of a few days all of the four shoats inoculated with the disease producing blood were displaying more or less clearly symptoms of the disease.

"Before the last of the four inoculated shoats succumbed the entire eight unprotected animals were sickening and showing positive signs of the development of the infection from the four which were inoculated with the cholera producing blood. This served to show the thoroughness of the exposure to the disease which the eighteen treated pigs were receiving through mingling constantly with their sick companions. However, the treated eighteen continued to thrive without

any apparent interruption to their normal development and ate normally.

"Summarizing the test, the results were as follows:

" 'The four animals inoculated with the disease producing blood died and post mortem examinations showed satisfactory evidence of cholera in each instance.

" 'The eight animals which were neither inoculated with the cholera blood nor treated with immunizing serum, but simply exposed to the infection by being allowed to mingle with the four which were given cholera, all died in the proper course of time, excepting three, two of which were stolen and one which is still sick and may recover. Autopsies in these cases revealed clearly the cases of hog cholera.

" 'The eighteen animals to which the immunizing serum was administered on July 28th are, at this writing, in an apparently healthy and normal condition, having made satisfactory growth during the progress of the experiment.'

"The object of the demonstration was to illustrate beyond question the efficacy of the serum treatment of hog cholera, and it has been most successfully achieved. It simply shows that the serum treatment properly administered will make it possible for the farmer to protect his swine herd against cholera outbreaks in his neighborhood or even on his own place."

In the Twenty-seventh Annual Report of the Bureau of Animal Industry the Chief of the Bureau reports that besides the limited number of demonstrations of the value of the serum in Maryland, Virginia, Illinois, Missouri, Iowa, Kansas, Kentucky and Tennessee, a thorough test was made at the stock yards at Kansas City, Mo., upon the request of the Kansas City Live Stock Exchange and of other persons interested in the subject. The following is the synopsis of the tests and results given in the report:

"Thirty-five young shoats were purchased from a farm where hog cholera had not existed. These pigs having been carried to the Kansas City Stock Yards, and being in charge of a committee appointed by the exchange, were treated as follows: Twenty-two were injected with the anti-hog-cholera serum prepared by the Bureau. Four were injected with virulent hog-cholera blood. Nine were not treated in any manner. All were placed in a pen together. As was expected, the four pigs inoculated with the virulent blood contracted hog cholera within a short time and all died. The nine "checks" contracted hog cholera from those which were inoculated with hog-cholera blood, and they also died. The 22 pigs treated with the serum remained well, with the exception of one or two, which were slightly affected on one or two days. It is not certain, however, that the trouble with the immune hogs was hog cholera, as none died. All the autopsies on the check animals showed typical lesions of hog cholera. No more convincing proof of the efficacy of this serum could be obtained than is afforded by this experiment."

Some of the reports made to me verbally from the use in Maryland of the serum of a certain commercial firm have been unfavorable, but I am unacquainted with the details of the use of the serum in these cases and I am therefore unable to decide whether the serum was properly employed or not, but I am inclined to believe from what I could gather that the serum was used only upon hogs that were already suffering from the disease. As the serum is not a cure, but strictly a preventive agent, this would explain the unfavorable results provided my surmise is correct. These are the only unfavorable results I have found, whereas there are a great many reports of success in Maryland.

For example, Dr. C. E. Poe, Hagerstown, reports that he made the following test: A herd of 37 hogs were all injected with anti-hog-cholera serum. Two of the hogs showed signs of the disease at the time that they were injected, and others were probably sick. Of the 37 so treated 20 have died, and other hogs in the herd are sick. This shows that the serum was not efficacious as a cure. But while these hogs were dying of the disease, 11 healthy hogs were inoculated with serum obtained from this station and placed with the sick hogs. None of these 11 inoculated hogs have shown any signs of the disease. This is evidence that the serum acted as a protection. The serum used on the original 37 hogs was not obtained from the station, but even if it had been, it would scarcely have proven of any benefit used in that way.

The serum itself is never at fault in those cases in which it fails to give satisfaction, and there will always be found a good and sufficient reason why the hogs in such cases are not protected in spite of the serum. A case in illustration of this point has been recently shown up by R. A. Craig,* Purdue Experiment Station. In reply to a request for an explanation as to why the serum simultaneous treatment failed to protect the hogs in a certain case in which the animals became sick of hog cholera from five to six weeks after the inoculation, Dr. Craig says: "The causes of pigs losing their immunity following vaccination by the double method are vaccinating with blood of little or no virulence, and the vaccination of pigs that are so small that they outgrow their immunity. In this herd the loss of immunity was due to the blood not being virulent."

If the protective serum has sufficient potency, that is to say if it will protect test pigs in the dose of say 20 c. c. to the 100 pounds of weight, and if the virus is so virulent that 2 c. c. of it or less will certainly produce the disease in uninoculated hogs no matter what their weight, and if furthermore a sufficient dose of the serum is given, and the virus injected into the hog at a different place from the serum—if all of these conditions are fulfilled—the hogs will be protected as surely as if they had passed through an attack of hog cholera.

Doctor W. G. Benner, of the United States Department of Agriculture, injected a number of hogs during an outbreak of the disease around Brunswick, Weverton, Petersville and Knoxville during an outbreak of the disease in those localities in the fall of 1912. Dr

---

*Cholera Attacking Vaccinated Hogs. The Breeder's Gazette., Feb. 19, 1913, p. 461.

Benner used serum furnished him by the Biochemic Division of the Bureau of Animal Industry. Through the courtesy of Dr. Richard W. Hickman, Chief of the Quarantine Division, Bureau of Animal Industry, I obtained a list of the places where Dr. Benner administered the serum on this occasion, and I have corresponded with the owners of the hogs for the purposes of finding out the results of these inoculations.

The replies obtained from these inquiries were all very favorable where the inoculations were made on well hogs.

Mr. James H. Harrison, Knoxville, wrote that he was satisfied that if his hogs had not been inoculated that he would have suffered severe loss from the fact that the disease was prevalent all around him while he had no cases on his place.

Mr. John N. Souder, Brunswick, wrote that he is satisfied that the injections saved his hogs. The disease was prevalent in his neighborhood at the time the hogs were inoculated, but his hogs all escaped.

Mr. William Runkles, Knoxville, had two sick hogs, one of which was inoculated and recovered, the other was not inoculated and it died.

Mr. Peter Nicodemus, Brunswick, lost one out of the five that were injected, but this animal was very sick when treated. He is satisfied that the inoculation saved the four hogs. He did not expect the sick hog to recover, in fact, he slaughtered it when it got very sick.

Mr. Clinton E. Miller, Weverton, wrote that in spite of the fact that the disease was all around him, even at his nearest neighbor's his hogs, 14 in number, inoculated by Dr. Benner all remained perfectly well.

Mr. Henry Hoffman, Petersville, wrote that his hogs all remained perfectly well.

Mr. Henry Sigler, Petersville, wrote that his hogs all escaped infection after being inoculated by Dr. Benner.

Mr. C. W. Virts, Knoxville, reported that he lost over 100 hogs before his herd was treated by Dr. Benner, and that he did not lose a single one of those inoculated. This shows the good results often obtained in cutting short an outbreak.

The evidence given above shows clearly that if hogs are inoculated with the serum before they are infected, and if the serum is used in sufficient doses, the disease will be very largely prevented. While the results are not so good where the serum is used on the apparently well hogs in a herd in which the disease has started, it is nevertheless, good even in such cases, for in this way a large number of hogs may be kept from becoming infected, though it will not cure any of the hogs that are already attacked.

The Nature of the Protection Afforded by the Use of the Serum.

The protection afforded by the use of the serum does not last indefinitely. After a few weeks or a month or more, varying in different cases, it disappears and the inoculated hogs become susceptible again.

The immunity conferred by the use of the serum alone is spoken of as passive immunity. It differs from the immunity enjoyed by an animal which has recovered from an attack of the disease. The immunity resulting from recovery from an infectious disease is lasting; it may last for the life of the animal. Hogs that have once passed through hog cholera are rarely if ever again susceptible to the disease. In this case the immunity is called active immunity. Now if a hog is inoculated with anti-hog-cholera serum and at the same time with some of the blood from a hog that is suffering with hog cholera, the hog so inoculated acquires active immunity. This is known as the simultaneous method of inoculation. By the use of the simultaneous method the animal is protected for life, just as if it had recovered from an attack of hog cholera. Since this active immunity is so much more lasting than the passive immunity resulting from the inoculation of the serum alone, it is to be recommended that all hogs that are inoculated with the serum be given at the same time a dose of blood from a hog suffering from hog cholera. If, however, hog cholera has already attacked the herd, the inoculation with the disease blood can be omitted; since the hogs that are inoculated with the serum in this case are exposed to the hog cholera contagion which is equivalent to injecting them with disease blood.

General Consideration of Immunity.

It is a matter of common experience that certain individuals, both human beings and lower animals, enjoy immunity from some infectious diseases to which other individuals of the same species are more or less susceptible. In fact there are whole races of human beings and of animals which are exempt from certain infectious diseases to which other races are susceptible. Certain individuals escape smallpox, typhoid, measles, cholera and other infectious diseases in times of epidemic while others are attacked under exactly similar conditions. The African race is less susceptible to malaria than the Caucasian, but it is more prone than the latter to suffer from tuberculosis. The Algerian sheep has immunity from anthrax, a disease which carries off hundreds of sheep of other breeds. The mouse will withstand a dose of diphtheria toxin which will kill several horses or many quinea pigs.

These are examples of natural immunity as applied to racial insusceptibility, or of individual immunity as applied to the resistance to infection shown by individuals during an epidemic.

But even if immunity from any given disease is not possessed by the individual originally, this may be acquired by passing successfully through an attack of the disease, as every one knows. The body of the susceptible animal comes through the conflict—if it comes through at all—with greatly increased ability to resist subsequent assault of this particular enemy, though it may be just as susceptible to attack or even more susceptible to attack by some other infectious disease. A child that has recovered from an attack of scarlet fever seldom or never suffers a second time from this disease, but it is just as liable to be-

come attacked by measles as if it had not had scarlet fever. Immunity following an attack of an infectious disease is consequently specific.

The animal body is provided, however, with general weapons of offence and of defence which it employs in the first place to ward off infection of any and every kind of infectious germ. The outer skin and the mucous membrane lining the mouth, the stomach and intestines, the genito-urinary tract afford a very efficient protection against invasion. The normal secretion of the eye is germicidal. But if the germs of disease overcome these outposts and gain entrance to the body, they may still be destroyed by certain cells, the white corpuscles of the blood and other cells of the body, as well as by the body juices, notably by the serum or liquid portion of the blood. But the germicidal properties of the cells of the body and of the body juices does not exhaust the defensive mechanism of the body. The body has the power of producing certain substances which resist the injurious action of the disease producing germ even if the germ overcomes the germicidal action of the cells and juices, and multiplies in the body. The injurious action of disease producing germs consists for the most part in the production of poisonous substances by the germs after they enter the body. These poisonous substances produced by the disease germs are called toxins, and the substances which the body produces to counteract the injurious action of these toxins are called anti-toxins or also anti-bodies.

Now these anti-bodies are not normally present in the body, or rather they are not free to act; on the contrary, they are only set free under the stimulus of the disease producing germ, and the question as to the victory in the fight between the sick body on the one hand and the invading germ on the other rests upon whether the body manufactures enough of the anti-bodies to counteract the otherwise fatal effects of the germ, or whether on the contrary, the germ produces more of the toxin than the anti-bodies are able to neutralize.

If the victory rests with the animal, there is always finally an excess of the anti-bodies in its blood over the amount actually required to overcome the toxin, there is a lavish production which is in accord with Weigert's law of overproduction. And this hyper-production is kept up for a longer or shorter time even after the enemy has been routed. Furthermore, if the animal body which has overcome the disease germ be further injected with the disease material either in the form of cultures of the germ, or in other cases with the products of growth of the germ, or finally in other cases still with the blood of an animal suffering with the disease, the body so injected produces a very large amount of the anti-bodies. Now the anti-bodies produced in this way constitute the various anti-toxins and anti-serums which are now used with such great success in several diseases of human beings as well as of animals. In some cases the anti-serum is produced by one of the methods mentioned above, in other cases by another one of these methods, but in every case after the animal has been injected its blood is drawn after a certain lapse of time, generally ten days or two weeks, and the liquid part of this blood constitutes the anti-serum.

The Production of Anti-Hog-Cholera Serum.

The principles upon which the production of anti-hog-cholera serum is based is the same as that just described for the production of anti-serums in general. In detail the process consists in taking a hog that has recovered from hog-cholera or in injecting a normal hog with anti-hog-cholera serum and injecting the animal with the blood of a hog that is suffering with an acute attack of hog cholera. Not only the blood of the sick hog, but also extracts made by leaching out the organs of such an animal as well as the urine of the animal my be used. The diseased blood obtained from the hog-cholera hog is whipped with glass rods, or in an egg beater so as to rid it of the fibrin or clot, and the liquid portion that is left is injected preferably into the ear vein of the hog that has recovered from hog cholera, or of a hog that has been treated some ten days previously with a dose of anti-hog-cholera serum. Instead of injecting into an ear vein, the virulent blood may be injected under the skin. Where the quick method is used, 500 c. c. of the disease blood is injected at one operation, where the slow method is used smaller doses are injected at frequent intervals. The method most usually employed is the quick method, but an advantage in the practical production of serum of the slow method over the quick method is that there is often a small amount of virulent blood or of the organs of a sick hog which can be used up in this way to good advantage.

The hog that has recovered from an attack of hog cholera, or which has received a dose of the protective serum is called an "immune," after it is injected with the disease blood it becomes a "hyperimmune."

In order to obtain the anti-hog-cholera blood from the hyperimmune, the bleeding is done from the tail of the animal, with proper precautions against contamination. For this purpose the tail is carefully scrubbed with soap, and swabbed off with an antiseptic solution, carbolic acid or creolin. A small hole is cut in the centre of a piece of cotton cloth a few inches square, and this is wet with the disinfecting solution. The hog's tail is run through the hole in the cloth, and the cloth slipped back until it reaches the root of the tail, and is then spread over the part of the rump around the tail. The tail is then dipped in hot water (for a time) so as to cause a free flow of blood, or it may for the same purpose be wrapped in a cloths wrung out of hot water, or it may be heated with an electric bulb, or otherwise treated so as to cause active circulation. A small bit, of the end of the tail is cut off by placing a block under the tail and using a sharp knife or chisel and mallet. The blood is caught in a carefully sterilized pan or jar, and as soon as practicable the blood is whipped with an egg beater or with glass rods to remove the fibrin which soon begins to clot. Of course every precaution is used to avoid contamination. In some serum plants, covered pans of about 1,000 c. c. capacity with removable covers are used, the covers each having a cylindrical tube projecting upward from it opening into the pan. The tail is stuck down into this tube after the end is cut off, and the blood caught in the pan.

A piece of cotton wet with the disinfecting solution is wrapped round the root of the tail down to where it enters the tube.

The hyperimmune may be bled in this way about every ten days, and hogs weighing 150 to 200 pounds furnish from 800 to 1,000 c. c. of serum at every bleeding. After the fourth bleeding the hyperimmune may be reinjected with virulent blood, and bled again four consecutive times at intervals of ten days. This bleeding and rehyperimmunization may be continued as long as there is sufficient tail left for the purpose. When it is no longer possible to bleed from the tail, the hog's throat is cut, and all the blood possible obtained. The carcass is perfectly good for use for human consumption, provided it is sound in other respects.

Testing the Strength of the Serum.

The potency of the serum is determined by injecting healthy young hogs weighing 40 or 50 pounds, each with disease blood and at the same time with different sized doses of the serum. In some places ten young hogs are used for each test of this kind, in other places fewer are employed. But in all cases the object is the same, and that is to determine the amount of the serum which will protect hogs from the disease. Where ten young hogs are taken for the test, they are each given 2 c. c. of blood from a hog that is suffering from hog cholera. Two of them are given none of the protective serum to be tested, but are kept as a check test to be sure that the blood employed is really virulent. Two others are each given 5 c. c. of the serum to be tested in addition to the disease blood, or virus as it is called, two others are each given 10 c. c. of the serum to be tested, and the two remaining are each given 15 c. c. In reckoning the proper dose for immunizing purposes from the results of this test, the weight of the hogs is considered, and the amount of serum used on the hogs which survive from the smallest dose per 100 pounds of body weight is regarded as the standard for that serum. For the sake of illustration, suppose the hogs receiving the 10 c. c. each and those receiving 15 c. c. each survive, while these receiving 5 c. c. and those receiving no serum all die. And further suppose that each of the hogs that received the 10 c. c. each weighed 50 pounds, then the calculation would be as follows: If 10 c. c. of serum protects 50 pounds of live weight, 20 c. c. would protect 100 pounds, and accordingly the potency of the serum is recorded as 20 c. c. for 100 pounds, and a proportionately smaller or larger dose for a smaller or larger weight. It is in all cases to be recommended not to use too small a dose, since it is a waste of time and money to use an amount of serum that is inadequate, while it does the hog no harm to use more of the serum than is necessary. A few cents worth more of serum can make all the difference between protecting the hog on the one hand or having it contract hog cholera on the other.

Methods Employed in the Use of the Serum.

There are three methods in use in administering the anti-hog-cholera serum. The first consists in the injection of the serum alone, the second consists in injecting the serum along with a small amount, 1 to 2 c. c., of the virus, and the third method consists in injecting first the serum alone, and about 10 days later injecting another dose of the serum along with 1 or 2 c. c. of the virus. The first of these methods is called the "serum alone," the second is called the "simultaneous method" and the third is called the "combined method."

Of the three, the combined is the most efficacious, and the safest. The somultaneous is next in efficacy, but is attended with possibly some risk. In fact some hogs have been given hog cholera by the use of this method due perhaps to the use of virus which was more potent than the dose of serum administered. The Hungarian authorities, according to the report of Eichhorn, have had some bad results from the use of 2 c. c. of the virus in the simultaneous method, and they have had much better results from using 1 c. c. The serum alone is to be recommended in case the animals to be injected are to be at once put in the fattening pen, since they will be protected for 6 or 8 weeks, long enough to guard against infection during the fattening time.

Whenever it is feasible to do so it is to be recommended that the serum be administered by a properly qualified veterinarian, particularly where the simultaneous method is employed. The administration of the virus along with the serum makes this procedure more or less dangerous from the fact that any of the virus that should happen to be spilled in the manipulation is capable of spreading the disease to uninoculated hogs. Still, after all, this danger is negligible in most cases for the reason that the virus is only employed in cases where the hogs are being inoculated with it at the same time with the serum.

Where the animal to be injected is not too heavy to be handled, it may be held up by the hind legs, head downward with the back between the legs of the man who is holding the animal (Fig. 1). Where the animal is too large to be handled conveniently in this way, it should be thrown and held securely on the side (Fig. 2). In the case of very large hogs, or in the case of pregnant sows, it is necessary to secure the animal in a standing position (Fig. 3). I have employed an ordinary shipping crate in many cases with advantage.

The place selected by most of those engaged in injecting the serum is inside the ham in the loose tissues of the groin. Some have raised objection to this method on account of the possible injury to the ham, and these operators recommend the loose tissues behind the ear. Practically it is of little importance where the hog is injected, and the points mentioned have been selected merely because of the convenience. The tratment will be equally effectual no matter where the hog is injected. The site of injection should be thoroughly soaked with 3 per cent carbolic acid solution or with creolin or cattle dip or some other efficient disinfectant.

Fig. 1.—Method of holding small hogs for inoculation.
(Photograph by R. H. Waite.)

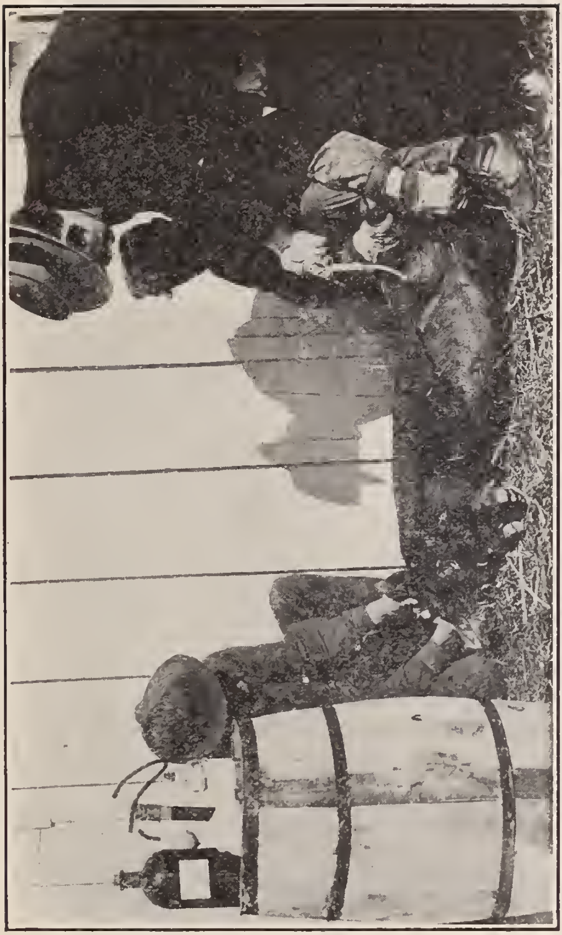


Fig. 2.—Method of holding large or medium sized hogs for inoculation.
(Photograph by R. H. Waite.)

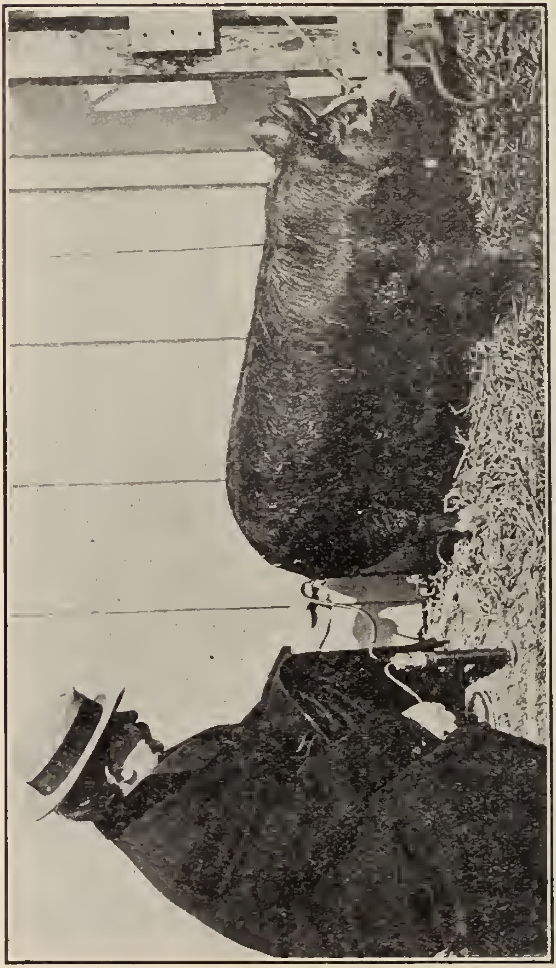


Fig. 3.—Method of controlling large hogs or those that are pregnant. In addition to the rope around the upper jaw, the animal has to be held by the tail by an assistant not shown in the photograph.

(Photograph by R. H. Waite.)

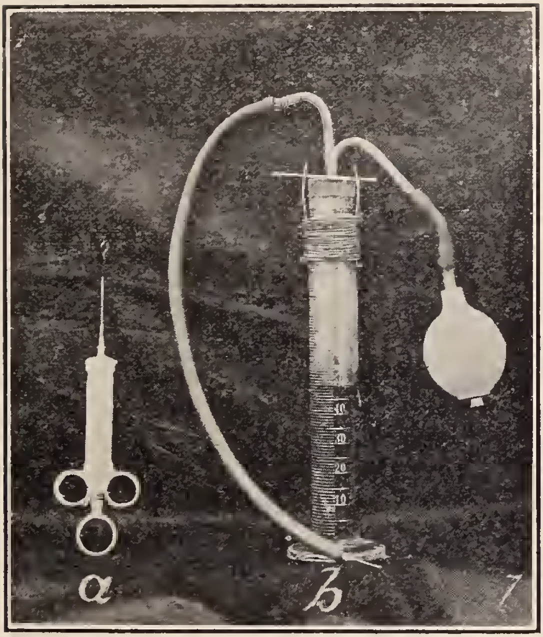


Fig. 4.—*a* ordinary hypodermic syringe, large size. When used this syringe should have the needle attached to the syringe by a rubber tube as shown in figure 2. *b* an inoculating device improvised out of a cylinder graduate and a rubber bulb, with rubber tube connections and a large hypodermic needle.

(Photograph by R. H. Waite.)

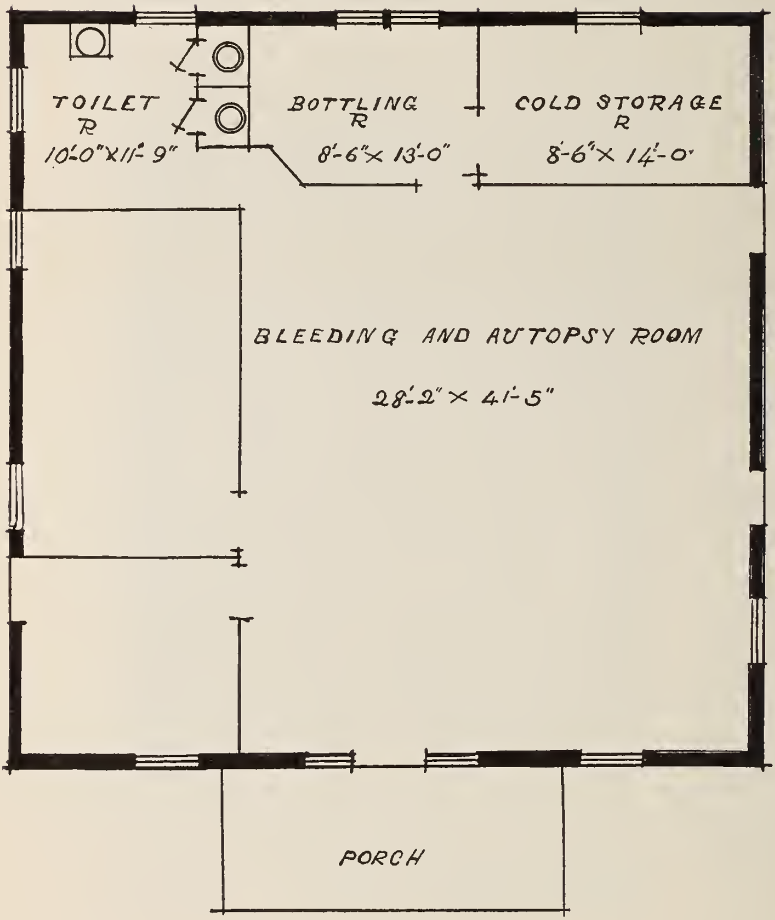

TOILET
R
10'-0"X11'-9"
BOTTLING
R
8'-6"X 13'-0"
COLD STORAGE
R
8'-6"X 14'-0"
BLEEDING AND AUTOPSY ROOM
28'-2"X 41'-5"
PORCH

Fig. 6.—The building which has been remodeled for use in serum production. Bleeding and autopsy room, cold storage and bottling rooms on the first floor. Laboratory rooms on the second floor.

(Photograph by R. H. Waite.)

The recommendation is usually to inject well into the muscle, and not merely under the skin. The kind of syringe employed is of little importance. It should be so constructed that it can be taken all apart so that it can be thoroughly cleaned. It should be put into a vessel of some kind and boiled in water for about 20 minutes before use, and it is well to sterilize it in this way between the injection of each animal. The syringe should be about 10 or 20 c. c. capactiy. Where the dose is large, it is well not to inject all in one place, but to inject a part in one place and part in another. Where the simultaneous method is used, the serum is injected on one side and the virus on the other, it is not advisable to inject the serum and virus in the same place.

Syringes for the injection of small and large doses of serum may now be obtained from the instrument makers. The syringe shown in Fig. 4, *a*, can be had in various sizes. It can be taken apart and thoroughly cleaned and sterilized. The piston rod is marked off and has an adjustable stop on it so that the dose can be accurately guaged. The barrel is of glass, and this makes it possible to note whether the serum is running out properly during the injection.

The syringe shown in Fig. 4, *b*, is improvised out of a cylinder graduate, and as is apparent, it is rigged up like an ordinary wash bottle. With this apparatus it is possible to administer large doses without refilling, or to administer a number of small doses with one filling.

It is important to have the needle connected with the syringe with a rubber tube so that the needle will not be snapped off in case the hog struggles.

The Maryland Legislature made an appropriation at the last session for the production of anti-hog-cholera serum at this station. This fund was available October 1, 1912, and before starting to make the necessary preparations for this work, information was sought from all available sources by correspondence, and the serum plants of Ohio and of Michigan were visited. It is due the officers of these institutions to state that I was accorded the greatest courtesy, and that I was given every opportunity to profit by my visit.

A synopsis of the replies to my writen inquiries received from the following places is given below.

Reports Received from Different States in Regard to Hog Cholera Serum.

Arkansas.—The serum is produced by J. F. Stanford, veterinarian of the University of Arkansas, College of Agriculture. According to the statement made in circular number 12, from this station, the Legislature appropriated $2,000 for two years, and requires that the serum and all instruments necessary for the administration of the serum be sold to the farmers at actual cost. In all cases where the serum has been used the results have been excellent even in those cases where the disease already existed at the time of the injection. The State Veterinary Department does not recommend the use of the simultaneous method, but will administer it if the owner insists; but they will not send the virus for administration by the farmer himself. The price was set at two or three cents per one c. c. Syringes are sold to the farmer at cost, $4.50 for a syringe of 30 c. c. capacity and $5.50 for a syringe of 80 c. c. capacity. The hogs used for the hyperimmunes weigh 200 pounds, and the statement is made that each hyperimmune will produce 3,000 c. c. of serum and requires five sick hogs weighing 50 pounds each, for the virus. The dose of the serum recommended is 20 c. c. per 100 pounds weight for the hogs which are to be treated. According to this statement, it takes five 50-pound hogs to produce sufficient serum for the protection of 150 hogs weighing 100 pounds each.

Arizona.—The reply from Arizona stated that no serum was produced by this station.

Alabama.—Have not heard from this State.

California.—The serum is produced at the Veterinary Department of the Agricultural Experiment Station by Dr. C. M. Haring, Veterinarian and Bacteriologist.

In a bulletin from the Experiment Station by F. M. Hays, Hog Cholera Preventative Serum, Bulletin No. 229, August, 1912, it is stated that the station has produced 600,000 c. c. of serum. This is enough to vaccinate 24,000 100-pound hogs, which has been sufficient to fill all demands except in a few instances where a few days were required to test the serum before it was shipped.

To produce this amount of serum it has required 174 hyperimmune hogs, and to hyperimmunize these hogs it has been necessary to use the blood from 230 virus hogs.

The method of distribution in California is to give 500 c. c. free of charge, and to fill any order for amounts above 500 c. c. at a price covering the cost of production.

The State appropriated $2,000 for two fiscal years for the use of the Experiment Station to be expended by the Regents of the University of California for carrying out the purposes of this act.

Colorado.—The serum is not manufactured by the Agricultural College in Colorado, but it is purchased by G. H. Glover, Head of Division of Theory and Practice.

It is distributed at cost to the farmers only through the hands of a registered veterinarian.

Dr. Glover writes that he regards the serum simultaneous method as very dangerous, and claims that the disease has been disseminated by this method of use. He thinks the treatment by either the serum alone or by the serum simultaneous method is attended with drawbacks.

Immunity from the serum alone lasts for only 30 days with any certainty.

The virus is refused to those desiring simultaneous treatment in parts of the State where the disease does not already exist.

Both methods are occasionally inefficacious.

Connecticut.—Does not produce the serum.

Florida.—This State does not produce the serum, but distributes it at cost through the State Board of Health.

The charge is 1¾ cents per c. c.

According to Dr. J. Y. Porter, State Health Officer, the serum is administered by representative citizens who have been selected in each community for the purpose.

It is necessary that the serum be not administered to the hogs before they are actually sick and then sufficient time is given to make sure that the outbreak is really hog cholera.

Delaware.—Does not produce the serum, but intends to start a plant in the future.

Georgia.—The serum is produced by Dr. H. H. Rothe, Instructor in Veterinarian Science, State College of Agriculture, Athens, Georgia.

The virus for immunization is obtained by the inoculation of susceptible hogs, and it is injected into the hyperimmunes in the proportion of 5 c. c. to one pound weight.

The hogs used for hyperimmunization weigh 100 to 200 pounds. The animal is bled four times after each hyperimmunization at intervals of one week.

An entire litter of pigs is used to test the potency of the serum.

At present the serum-alone method is used on account of the danger of spreading the disease by the use of the simultaneous method.

The serum with a syringe is shipped to the farmer on application.

The results of the serum-alone method are found very satisfactory.

Dr. Peter F. Brahnsen, State Veterinarian, in commenting upon the method of distribution states that it would indeed be better to have

the serum injected by trained men, but as yet it has been impossible to obtain appropriations for this purpose.

Idaho.—No reply on hand.

Indiana.—The serum is produced by Dr. R. A. Craig, Head of the Department of Veterinarian Science, who enclosed leaflet No. 21, in his reply, from the Experiment Station, and also photographs of the bleeding room and blank forms and circulars.

The work has been conducted for four and one-half years and is self-supporting.

The serum is distributed to the farmers by veterinarians and graduates from the College who have had experience in hog cholera work. Nearly 140,000 hogs have been treated by the simultaneous method with a loss in infected herds of 8 to 12 per cent, and in healthy hogs of 1 to 2 per rent.

Sucking pigs weighing less than 40 pounds, if their mothers are vaccinated or there is immediate danger of their becoming infected, are given a protective dose of serum alone and in four to six weeks the whole litter is given the simultaneous treatment.

Hogs with a temperature of over 103.5 degrees F. are not given the simultaneous treatment, but are given a dose of serum alone, 1½ times to twice the size of the immunizing dose.

Illinois.—The serum is produced on a very large scale by A. T. Peters, Bacteriologist of the State Board of Live Stock Commissioners, using 500 to 600 hogs, all the time.

250,000 head were treated during 1912 with a very slight loss.

The simultaneous method is the only one employed.

The serum is produced according to the Dorset-McBryde-Niles method.

The serum is distributed free to the farmers and is administered by competent veterinarians, the farmers paying for the services of the veterinarian.

The State appropriated $45,000 for two years for the production of the serum.

Iowa.—The serum has been produced for the last three years according to the Dorset-McBryde-Niles method.

The amount produced is limited for the reason that there was insufficient appropriation made by the State.

Kansas.—The serum is produced on a very large scale by the Veterinary Department of the Experiment Station at Manhattan.

The production is under the direction of F. S. Schoenleber.

In Farmers' Bulletin No. 182, of the Experiment Station, it is stated that of 292,000 hogs treated during the year 1911 the loss was very small. According to the report received the loss in non-infected herds, with the serum alone amounted to only one per cent. In infected herds there were over 69 per cent of the animals saved and then, in many cases the disease had made great progress before the serum was administered.

The combined method, i. e., serum alone followed by the simultane-

ous method, is very strongly advocated. The first injection with the serum alone is followed by the simultaneous injection ten days later.

It is recommended that the injection be made back of the ears or under the jowl for the reason that the injection into the hams are sometimes followed by a discoloration of the meat in this location.

There is a law in Kansas forbidding the use of the virus even along with the serum, except by the authorities of the State College.

The serum is put up in bottles containing 50, 100, 200, 500 and 2,000 c. c., respectively.

The cost of production of the serum is about 1½ cents per c. c.

The plant is supposed to be self-supporting.

Kentucky.—The serum is produced by the Agricultural Experiment Station under the direction of E. S. Good, Head of the Division of Bacteriology

The laboratory was put up at a cost of $2,000. The work has outgrown this plant, and will be replaced by a larger building in the near future.

The virus used for hyperimmunization is, for the most part, cultivated intentionally by injecting susceptible hogs. The virus is injected into the hyperimmunes in the proportion of 5 c. c. of virus per one pound of hog.

The custom is to bleed at intervals of one week apart allowing ten days from the hyperimmunization to the first bleeding: 4 c. c. are drawn per one pound weight of hog; the injection of virus is made into the ear vein.

The dose of serum recommended is 40 c. c. per 100 pounds, and the virus dose is 2 c. c. for 50 pounds and proportionately less for lighter hogs and proportionately larger for heavier hogs.

For the most part the serum is administered by men employed by the station. The services and the railroad fare is furnished by the State, but the serum is charged for at the rate of one cent per c. c. and the same for the virus.

Maine.—Does not produce serum.

Massachusets.—Does not produce serum.

Michigan.—The serum is produced in the laboratory of Bacteriology and Hygiene at the Michigan Agricultural College, East Lansing.

It is sold to any one applying for it whether farmer or veterinarian and the serum-simultaneous method is recommended and employed. The price charged for the serum is two cents per c. c. and is sent by express C. O. D.

The hyperimmunes used are injected with the virus by the slow intramuscular method. In order to obtain as much virus as possible from the virus pigs the animals are injected previous to bleeding with normal salt solution.

The serum alone method is recommended where the hogs have a high temperature, but in other cases the simultaneous method is recommended.

Minnesota.—The serum is produced at the Experiment Station by M. H. Reynolds.

Hogs inoculated with the serum alone acquire immunity if exposed afterwards to the disease.

The amount of serum produced by the station is not stated.

The dose recommended for hogs weighing from 50 to 100 pounds is 20 c. c.

There is little or no danger of spreading the disease by the serum simultaneous method, unless the hogs become very sick and this is rarely the case.

Mississippi.—The serum is produced by E. M. Ranck, State Veterinarian, who has published a circular with directions for the use of the anti-hog-cholera serum, with the dose to be administered per body weight and with precautions to be employed in its use. He states that the serum alone protects for about three months and advises exposing animals which have been injected with the serum to contact with diseased animals so that they may, in this manner, acquire a permanent immunity. The serum simultaneous method is recommended to those who desire to immunize their animals permanently. Where the serum alone method is employed the dose recommended is 30 c. c. per 100 pounds weight and proportionately more or less for larger or smaller animals, but, it is recommended that where the simultaneous method is employed that the dose of the serum be increased one-fourth.

The amount of virus recommended where the simultaneous method is used is one-half c. c. for small pigs, one c. c. for 50 pounds to 100 pounds, two c. c. for all over 150 pounds.

The serum is charged for at the rate of 1½ cents per c. c.

The results so far have been very favorable.

All anti-hog-cholera serum offered for sale in the State is tested under the direction of the State Veterinarian.

Missouri.—Received no reply as yet.

Montana.—Does not produce serum.

Nebraska.—The serum is produced under a Legislative appropriation of $15,000. This fund was found to be ample, as the serum is sold to the farmers at two cents per c. c.

The simultaneous method is used very little, but where it has been used it has been found satisfactory.

The intravenous method for hyperimmunizing is the one employed, and 10 c. c. of virus are injected per pound. As usual, after the three bleedings the hyperimmune is injected again with virus.

Syringes are also supplied at cost. The serum is sent to any one on application.

Nevada.—The serum is produced in a limited amount by W. B. Mack, Department of Veterinary Science and Bacteriology, Agricultural Experiment Station, Reno, Nevada.

The serum is administered by Dr. Mack himself, except in a few cases. He immunizes the hogs by the injection of 10 c. c. of virus per pound weight subcutaneously in three or four injections.

Bleeding the hyperimmunes four or five times then rehyperimmunizing.

Contrary to the usual practice he has used serum upon sick hogs with high temperatures in the early stages of the disease with very excellent results.

He has had some bad results from the use of the serum on the pure bred hogs belonging to the station, and suggests the possibility that pure bred animals are more difficult to protect than ordinary hogs.

It is probable that the station will abandon the production of the serum in the future, and will purchase it from outside sources.

New Hampshire.—Does not produce the serum.

New Jersey.—The serum is bought from the Agricultural College at Michigan and is distributed to the farmers direct.

The results so far obtained are very excellent.

New Mexico.—Dr. Luther Foster, Dean of the College of Agriculture, points out that so far New Mexico has been spared from hog cholera and therefore there has been no need to produce the serum.

New York.—The serum is produced at the New York State Veterinarian College, Cornell University, Ithica, by Howard J. Milks.

The slow method of hyperimmunizing is employed on account of the difficulty of carrying out the intravenous method. The intra-abdominal method has given very bad results owing to the fact that the animals injected in this manner have suffered from peritonitis.

The use in general has been satisfactory since those who have used the serum at one time usually send after a second amount. This is considered a good indication of the beneficial effects of the serum.

North Dakota.—The serum is produced at the Experiment Station, Agricultural College.

As far as possible, the serum is used by officers of the Live Stock Sanitary Board. Difficulty has been experienced in obtaining serum of sufficient potency.

Good results, on a whole, have been obtained.

No statement is made whether the serum alone or the serum simultaneous method is used.

Ohio.—The serum is produced by the State Live Stock Commission, under the direction of Paul Fischer, State Veterinarian. The virus for hyperimmunizing and for the simultaneous method is obtained from spontaneous outbreaks and also from hogs intentionally inoculated. The injections of virus are made in the ear vein.

The serum simultaneous method is employed almost exclusively, and with very excellent results. It is administered only by members of the staff who are qualified veterinarians.

The charge is two cents per c. c. for the serum and for the virus. Services of the veterinarian are not charged for.

Oklahoma.—The hyperimmunization is performed by the slow method, the intravenous method having been followed by bad results.

The serum is distributed to the farmers directly and where the simultaneous method is employed, the virus must be used by a veterin-

arian except occasionally where the farmer has already used the serum, he is entrusted with the virus five to seven days later.

The serum is produced by L. L. Lewis, Veterinarian, at the Agricultural Experiment Station, Stillwater.

Oregon.—Does not produce the serum.

Pennsylvania.—The serum is produced at the laboratory of the State Live Stock Sanitary Board near Philadelphia. Dr. K. F. Meyer, Director of the laboratory, wrote that he employs both "slow" as well as the quick method for hyperimmunizing the hogs. By using the slow method in certain cases he is enabled to make use of extracts of organs and the urine from the hogs from which he gets his virus and from other hogs sick of hog cholera. Under favorable circumstances he can use the same hyperimmune for four or five months. These hogs are bled usually four time and then rehyperimmunized.

The potency of the serum is tested out on six small hogs, weighing about 75 pounds each, which are given respectively 40 c. c., 30 c. c., 20 c. c., 10 c. c. and 5 c. c., along with a fatal dose of virus; the sixth hog being given the virus alone as a test of the virulence of the virus. If the hogs receiving 10 and 20 c. c., respectively, each becomes sick, but recovers, then three times the smaller dose, 30 c. c. are set down as the dose of this particular batch of serum. The serum is preserved by the addition of one-half per cent of carbolic acid and one per cent of glycerine.

The serum is applied by registered veterinarians only, and where the serum simultaneous method is used, by an assistant of Dr. Meyer only.

On infected premises the serum alone is used, in other cases the serum simultaneous treatment is given.

The experience with the treatment in Pennsylvania has been very favorable.

Rhode Island.—Does not produce the serum.

South Carolina.—The serum is produced at the Clemson Agricultural College by the State Veterinarian, M. Ray Powers.

In bulletin 168 the statement is made that the anti-hog-cholera serum, when injected alone, gives immunity for from four to eight weeks, but this immunity becomes more permanent when the injected hogs are exposed to infection.

The serum simultaneous method is not recommended for stock owners owing to the danger of spreading the infection and for this reason virus is not supplied; but it is recommended very highly in the hands of properly qualified persons. The serum alone is recommended wherever an outbreak of cholera appears and in hogs whose temperature does not exceed 104 degrees F. The dose recommended for sucklings is 10 c. c. and proportionately more for heavier hogs. Universal testimony is favorable.

The farmer is charged two cents per c. c. and with every order for serum a syringe is included and charged for. The price set for the syringe is $2.15.

The serum is distributed in bottles containing 110 c. c., 500 c. c., 1,000 c. c., respectively.

Texas.—The serum is produced at the Agricultural and Mechanical College at College Station, Texas.

The serum is sent to any one on application with the recommendation that a competent veterinarian will be employed to administer it.

The serum simultaneous method is condemned.

Tennessee.—Received no reply.

Utah.—Received no reply.

Vermont.—Does not produce serum.

Virginia.—Serum is distributed to the farmers at cost . It is distributed through the Department of Ariculture and Immigration, Hon. A. M. Koiner, Commissioner.

Washington.—Contemplates in the near future the production of the serum.

West Virginia.—Purchases the serum from a commercial firm and distributes it.

Wisconsin.—The serum is produced at the Agricultural Experiment Station, Madison. It is distributed at cost, 1½ cents per c. c. The use of the simultaneous method is restricted to the hands of properly trained men deputized by the State Veterinarian. For this purpose a man is employed in the field.

The serum simultaneous method is recommended for use in non-infected herds and in infected herds where the temperature is not above 103.5 degrees F. It is recommended to inject the serum into the arm pits, and not into the ham for the reason that this part of the body becomes spoiled for food. The serum alone is said to give immunity lasting only for three weeks or three months. It is optional with the owner of the animals which of the these methods be employed.

Wyoming.—Do not produce serum in this State.

Maryland Plant.

The ground floor of one of the station buildings has been specially altered to suit the purpose of producing the anti-hog-cholera serum. The building is shown in Fig. 6, and the rooms assigned to the serum production occupy practically all of the ground floor which is 40 feet by 40 feet, divided up as shown in the accompanying floor plan. The floor is of concrete. The rooms are amply lighted with windows, and the entire building is lighted artificially by a one kilowatt gasoline electric generator. This lighting system with a storage battery and the necessary fixtures and wiring has been furnished by the General Electric Company free of cost to the station.

For some time past the station has been supplying all demands made for the serum at a cost of two cents per one c. c.. or 40 cents a dose for hogs of 100 pounds weight. The serum thus far employed has been purchased from the Kansas Experiment Station, and until the Maryland plant gets in operation the hog owners will be supplied with this product which has given good satisfaction.

The Legislative enactment under which the serum will be produced is as follows:

LAWS OF MARYLAND,

JANUARY SESSION, 1912.

Charter No. 842.

An Act to establish a State Laboratory for the production, testing or standardizing of tuberculin, mallein, hog cholera serum and other biological products.

Section 1. Be it enacted by the General Assembly of Maryland, That the State Board of Agriculture shall establish, equip and supervise a Biological Laboratory for the production, testing or standardizing of tuberculin, mallein, hog cholera serum and other biological products needed for diagnosing, preventing, immunizing against or curing diseases among live stock in the State of Maryland, and to investigate and test biological methods and products that have apparent value in treating diseases among live stock.

Section 2. And be it further enacted, That the Director of the Maryland Agricultural Experiment Station shall be the Director of the State Laboratory for Biological Products and that the State Board of Agriculture shall on nomination by the said Director, appoint such persons as may be necessary to carry on the work of preparing, distributing or using the products of the Laboratory for the diagnosis, prevention, immunization or treatment of diseases among live stock in the State of Maryland and shall fix the compensation for the services of such persons.

Section 3. And be it further enacted, That the Director of the State Laboratory for Biological Products may at his discretion sell to regularly licensed physicians and veterinarians or charge for the administration of the products of the laboratory at approximate cost of the same as may be set from time to time by the State Board of Agriculture.

Section 4. And be it further enacted, That the Director of the State Laboratory for Biological Products shall, at the request of the State Board of Health, the State Live Stock Sanitary Board, or the State Veterinarian, and for State and public purposes only, pursue such tests or investigations with biological products, on and for animals as may be requested, provided the work in hand permits, and the cost is within the State appropriation.

Section 5. And be it further enacted, That there shall be appropriated out of any money in the Treasury of Maryland, not otherwise appropriated, the sum of five thousand dollars ($5,000), for the establishment of said Biological Laboratory, and for carrying out the purpose of this act the sum of five thousand dollars ($5,000), or so much thereof as may be needed, is hereby appropriated for the year 1913, and a like sum of five thousand dollars ($5,000) is hereby appropriated for the year 1914, to be paid to the said State Board of

Agriculture out of any money in the treasury not otherwise appropriated.

Section 6. And be it further enacted, That all Acts or parts of Acts that are inconsistent with this Act be and the same are hereby repealed.

Section 7. And be it further enacted, That this Act shall take effect July 1, 1912.

Approved April 11, 1912.

P. L. GOLDSBOROUGH, *Governor.*
JAS. McC. TRIPPE,
Speaker of the House of Delegates.
JESSE D. PRICE,
President of the Senate.

The
Great
Seal of
Maryland.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION

BULLETIN No. 175. MARCH, 1913.

MISCELLANEOUS INSECT PESTS.

By T. B. Symons and E. N. Cory.

Introduction.

As a general policy it seems best to discuss only one insect in a bulletin or the insect pests of a certain crop, but under present circumstances there are several insect pests affecting various crops about which the growers should be given a note of warning in order to prevent as far as possible serious injury the coming season. The year 1912 was rather notable from an entomological standpoint, several insect pests appearing in injurious numbers in the state which had not heretofore been considered with any degree of apprehension. Some well-known pests such as the Hessian fly, occurred in increased numbers causing severe injury in many parts of the state, so that it seems advisable to issue a bulletin giving brief accounts of those insects which may be expected to occur in increased numbers the present year.

In the discussion of some of the insects, the results of some minor experiments conducted during the past year will be given.

San Jose Scale.

(*Aspidiotus perniciosus*).

While this insect is generally under control in the State, there are some growers who have not as yet recognized the necessity of treating their trees for the pest, and there are many inexperienced men now entering the orchard business who are not familiar with the insect or the remedy for its control. The San Jose scale is a pest of all fruit trees, but will not usually be found on Kieffer pear or cherry in injurious numbers. All trees should be sprayed during the dormant

season, preferably in spring before the buds open, with the lime-sulfur remedy. There are some growers who cling to the old method of making the lime-sulfur wash, using 20 pounds of lime and 15 pounds of sulfur to 50 gallons of water, boiling one hour. Most progressive growers now employ the concentrated lime-sulfur solution. This can either be purchased from manufacturers or the solution can be made on the farm. When only a small orchard is to be treated, it is undoubtedly best to purchase the solution, but if there is a large number of trees to be sprayed, and the grower desires to practice economy, the solution can be made on the farm with little inconvenience. There is practically no difference in the effectiveness of a good home-made solution and a good manufactured product. It is quite certain that no grower should now bother with the old home-made lime-sulfur wash, as the concentrated is effective in controlling scale, and is much more convenient to use. For those who may desire to make their own solution, the following formula and method of preparation is considered the best.

Home-Made Concentrated Solution.

Best stone lime	50 lbs.
Sulfur (any kind finely ground, 98 per cent. pure)	100 lbs.
Water	50 gal.

Directions: Heat about twenty gallons of water in an iron vat or by steam in barrels to near boiling and add stone lime and sulfur gradually, to prevent boiling over. Vigorous motion will take place and cold water should be near at hand to be added gradually, to make a total of about 55 gallons. The solution should boil vigorously for one hour. It is then ready to be stored or to be diluted and used at once. In storing the solution it is necessary to exclude air from it as much as possible, by either filling up the barrel or other container completely with the liquid, or by putting a film of oil on the surface of the solution. The stored solution should be protected from extreme cold weather.

Application.

The concentrated lime-sulfur is usually diluted at the rate of one gallon of the solution to eight or nine gallons of water. Trees should be sprayed in the spring before the buds open. Where there is a great deal of spraying to be done part of the trees may be treated in the fall. In spraying for the scale, care should be exercised to hit all parts of the trees.

The Terrapin Scale.

(Lecanium nigrofasciatum.)

This scale insect continues to be troublesome in several peach orchards in different parts of the state, and while not generally distrib-

uted, growers should be on the lookout for its first appearance in their orchards. The terrapin scale is much larger than the San Jose, hemispherical in form and about two mm. in length, slightly less in width, mottled brown, with radiating streaks of black towards the sides, and an orange-red patch on the top, the sides being more or less ridged.

The loss to the orchardist from this scale insect is not so much through the damage to the tree as through the injury to the fruit.

The honey-dew, which is excreted in large quantities by the insects, often coats both the leaves and fruit, and furnishes an excellent host for a black fungus that renders the fruit practically unsalable at remunerative prices.

Remedy.

From results of our experiments in the past in the control of the terrapin scale, we recommend that a standard miscible oil be employed at a strength of 1-15, applied on the tree just as late in the spring as possible before the buds open.

We believe that such treatment at that time will be effective in killing the scale and at the same time be less likely to prove injurious to buds or twigs. We have contended in the past, and believe now, that treating peach trees with oil, may at any time be attended by injury, either to buds or twigs, or both; nevertheless, this is the only treatment that seems available, at this time, and even if some injury to the tree is occasioned, it is better to run the risk than allow the terrapin scale to continue to develop in the orchard. The dormant lime-sulfur remedy will not control the terrapin scale.

Apple Aphis.

(*Aphis sp.*)

From an examination of many orchards throughout the state, there appears to be an unusual number of little black eggs deposited around the buds on terminal twigs. These are the eggs of the apple aphis, which hatch into tiny green aphids just as the buds put out. The aphids feed on the tender leaves by sucking their juices, and often cause considerable injury to the young growth. There may be at least two species of aphids.

Remedy: In pruning trees it is well to watch for twigs badly infested with eggs of this insect, so as to cut them out where possible. The dormant season spraying with lime-sulfur solution would also destroy many of these eggs.

If the young insects appear in large numbers just as the foliage is developing, they can be controlled by spraying with "Black Leaf 40" (sulphate of nicotine), using it at the rate of one part of the solution to six to eight hundred parts of water. When applying this solution alone it is best to add three or four pounds of soap to every 100 gallons of diluted spray.

Formula:

Black Leaf "40"	1 pint.
Soap	1 to 3 lbs.
Water	100 gallons.

(This dilutes Black Leaf 40" 1 to 800).

In various experiments made by this department during the past two or three years, we have found "Black Leaf 40" to be one of the best and most convenient insecticides for killing plant lice affecting various crops.

The solution can be bought from the Kentucky Tobacco Product Company, Louisville, Ky., or from local dealers. The material sprays well and if properly diluted will in no way injure foliage or fruit.

Kerosene emulsion used at the rate of 10 per cent. will also effectively control the apple and similar aphids.

Formula:

Kerosene (coal oil)	2 gal.
Warm water	1 gal.
Soap	½ lb.

In preparing kerosene emulsion, shave up a half pound of laundry soap in one gallon of hot water. As soon as soap is dissolved, remove the solution from the fire and add two gallons of kerosene. The solution should then be agitated violently, until a creamy emulsion is formed without any free oil. This can best be done by the use of a bucket pump, turning the nozzle back into the bucket, pumping the solution through the pump.

Woolly Apple Aphis.

(*Schizoneura lanigera.*)

This aphis is also very common in the apple orchards, occurring both on the twigs and branches and on the roots. The woolly aphis is readily detected by the bluish-white cottony or downy substance that is excreted by it and covers the greater part of each wingless individual, and since these insects live in colonies, the patches of white matter are very conspicuous. The presence of the aphis under ground is readily detected by removing the earth from the roots near the trunk of the tree. The principal injury is done to the roots of trees, where they produce wart-like swellings and excrescences varying much in shape and size. The woolly aphis is easily controlled when attacking the branches or twigs of apple trees, by the application of ten per cent. kerosene emulsion. Black Leaf has not sufficient penetrating powers to be successfully used against this pest. To control effectively and economically the insect on roots of young or old trees, has been a subject of investigation by this and other stations. The free use of tobacco dust around the roots of infested trees has been considered the most practical remedy, but after numerous observations of the failure of this treatment we are now testing out the use of other materials as follows:

Apterite, tobacco dust, One-For-All, Soluble Oil, Scalecide, Lemon Oil, Kerosene emulsion, Electro Insecticide Soap, Nico-Sul., Electro Pine Tar Creosote, lime-sulfur, Tanglefoot and Tree Leim. These were used in various ways and at different strengths, constituting an extensive series of tests, that will be repeated this year. These tests were made in the apple orchard of Mr. E. W. Hungerford, Marshall Hall, Md., on May 25-26, 1912. In addition to the above, Apterite, tobacco dust, Pine Tar Creosote and kerosene emulsion were applied in an orchard at College Park. Kerosene emulsion was applied in the orchard of Mr. R. A. Spence, at Elkridge, Md.

These tests will be continued in 1913, and no conclusions can be drawn at this time.

Remedy.

From our observations and results of R. I. Smith, in Georgia, 1907, it would seem that the use of ten per cent. kerosene emulsion promises to be one of the most effective solutions to use against this insect on the roots as well as branches of trees.

Growers should be careful to see that all young trees are free of the pest when planted, and scars resulting from bad pruning or other injuries to bark of trunk and branches, should be guarded against as much as possible to prevent a favorable location for aerial forms of these aphids.

The Hessian Fly.

(*Mayctiola destructor.*)

This is one of the oldest and most serious insect pests that attacks the wheat plant in this state. While the loss caused by the insect is periodical, the large increase of injury during the past two years makes necessary a word of warning to the farmers of the state to watch their wheat fields this spring, and to guard against serious trouble another year.

The Hessian fly is a tiny two-winged gnat about one-fourth of an inch long. The adult appears in early fall and deposits her eggs upon the leaves of wheat. The larvae work their way into the stem to feed, later changing to the pupae or flaxseed stage, so called because of the resemblance to that seed. The adults from the over-wintered flaxseed puparia emerge during April or May. The life history is repeated, the flaxseed stage being reached before harvest. It remains in the stubble, and the adults emerge in late August and September. The insect injures wheat by the larvae or maggots feeding on the juices of the plant at its base, causing it to be stunted and preventing infested shoots from developing grain.

REMEDIES.

When grain is observed to be infested with the hessian fly in winter or early spring, it is best to pasture sheep in the field, to enable them to destroy the flaxseed stage by eating the wheat down to the roots.

As the insect passes the summer in the wheat stubble, if practicable, this should be burned over or plowed down after harvest as soon as possible. No volunteer wheat should be allowed to grow during the summer. Rotation of crops is very beneficial, but the adults can fly, and thus infest new fields.

On farms where the pest is serious, narrow plats of wheat should be sown in late summer, about September 1st to 10th, depending upon locality, as baits for the fly. Later in the fall this can be plowed down.

From observations and records, considering the latitude and altitude* at the various points (according to Hopkins' system) wheat should not be sowed in the surrounding country of the following cities and towns before the dates given:

Oakland	Sept. 12th-19th.
Hagerstown	Oct. 1st-7th.
Frederick	Oct. 3rd-10th.
Westminster	Sept. 28th-Oct. 5th.
Rockville	Oct. 2nd-8th.
Germantown	Oct. 2nd-8th.
Ellicott City	Oct. 2nd-9th.
La Plata	Oct. 9th-13th.
Cockeysville	Oct. 3rd-10th.
Bel Air	Oct. 2nd-9th.
Elkton	Oct. 2nd-9th.
Chestertown	Oct. 6th-13th.
Easton	Oct. 9th-16th.
Salisbury	Oct. 10th-17th.

Dates of sowing for adjoining sections to the above can be figured by moving forward the date of sowing one day for each one-quarter degree latitude north, and one day for each 100 feet gain in altitude from a given point.

In sections where the fly is very prevalent the farmers of the community should adopt a uniform safe period for sowing wheat in the fall. The Station will be pleased to advise growers concerning the dates for their individual locality at any time. The practice of sowing wheat with clover in early fall for hay in spring, should be discouraged as much as possible in communities where wheat is grown as a commercial crop.

*The Hessian Fly in West Virginia, and How to Prevent Losses from Its Ravages, by A. D. Hopkins, Ph. D. Bulletin 67, West Virginia Experiment Station.

The Fall Army Worm.

(*Laphygma frugiperda.*)

The mild winter of 1912-13 may be a factor in continuing during the coming season the infestation of the fall army worm that occurred last year in injurious numbers. Late in August there appeared in several parts of the state a serious outbreak of this pest. The worms occurred in enormous numbers, attacking alfalfa, corn, millet, lawns and other crops or plants in their vicinity. The appearance of the worms was so sudden and unexpected, that in many cases severe injury was done before remedial measures could be applied.

The worm is the caterpillar stage of a dark gray moth, having a wing expanse of one inch. This moth is one of the cut-worm moths belonging to the family Noctuidae. The worm varies from pinkish white to light green on the ventral side, and is dark brown above with two dark stripes extending the length of the dorsal side. The worm pupates just below the surface of the ground, emerging therefrom as a moth in about ten to twelve days.

Remedy.

The worms can be controlled readily by the use of a poisoned bait spread broadcast over the infested area about sunset. This bait is prepared by combining one-half pound of Paris green with 50 pounds of bran or wheat middlings, to which is added one gallon of molasses and enough water to form a crumbling mass. The worms are largely nocturnal feeders, and prefer the bran bait to green food. Applications of this poisoned bait applied at different places by a representative of the Station, proved efficient in controlling the pest.

A parasitic fly was very abundant last year, and did excellent work in reducing the numbers of the second brood.

The Pickle Worm.

(*Diaphania nitidalis.*)

The pickle worm, so called because in the South the chief damage has been to cucumbers, appeared in large numbers throughout Maryland last year.

The insect did not confine its attention to cucumbers, however, but melons, early and late squashes and pumpkins, suffered from its ravages.

The worm is the larva of a beautiful moth with a wing expanse of about one inch. The tips and margins of the silver colored wings are banded with copper-colored scales, and the body above is copper color. There is a triangular tuft of hairs on the tip of the abdomen.

The moth deposits her eggs in the blossoms of the cucurbits, and the larvae enter the young fruit. Here they feed and live until the

green caterpillars attain a length of one and a quarter inches. They then eat their way out, leaving an unsightly opening about three-sixteenths of an inch in diameter. The larva constructs a cocoon in the rolled edge of a leaf, and transforms to a pupa. The adult moth emerges in about two weeks. There are several generations annually.

Remedy.

The moths show a decided preference for early squashes, for oviposition, and this fact can be taken advantage of by the grower. A row of early squashes planted around the melon or cucumber patch will attract the majority of the moths, and the larvae can be destroyed by collecting and burning the blossoms and newly set fruit of the trap crop every few days.

The trap crop should come into blossom before the melons or cucumbers.

The destruction by fire of all rubbish and vines after the crop is taken, will aid materially in reducing the numbers of pests in the future.

The Locust Hispa.

(*Chalepus dorsalis*).

The leaves of the black locust trees have turned brown in July and August of the past three years. The injury has been widespread throughout the state, but has been especially noticeable along the valley of the Potomac River.

A small reddish brown beetle with black head and black stripes on the inner margin of the wing covers is responsible for the injury. This beetle deposits her eggs on the under side of the leaf near the edge. The larva enters the leaf and feeds between the two surfaces, forming a blotch mine. Several larvae may live in one leaf. The larvae pupate within the leaf.

When there is a bad infestation, the landscape is decidedly marred by this premature browning of large areas.

The hispa injured the foliage of trees on the College campus to such an extent that spraying seemed necessary. On June 22nd, 1912, the ravages of the locust hispa had about reached its maximum. The trees on the College campus showed considerable browning, and the beetle was present in all stages. Trees were sprayed on this date with four pounds of arsenate of lead to 50 gallons of water, the material adhering only fairly well. This one spray checked the adult feeding to such an extent that the trees began to recover, and maintained a green color for the balance of the year. Pupae were found in considerable numbers in the brown leaves that fell. This fact might form the basis for another control measure, i. e., raking and burning of the leaves throughout the summer and in the fall.

The use of one bar of laundry soap dissolved in the poison spray will help to make the material adhere to the foliage better.

Burning over the wood lots in late fall may prove beneficial.

The Orange Striped Oak-Worm.

(*Anisota senatoria.*)

The past fall a large majority of our pin-oaks were defoliated by a black and orange striped caterpillar about one and one-half inches in length. This worm has two prominent erect black feelers or "horns" on the head.

The worms pupate in the ground and emerge in the summer as light chestnut red moths of about two inches wing expanse.

While the major portion of the injury has been confined to the forest, many shade trees in towns have likewise suffered. The injury was severe in some of the nurseries. Two pounds of arsenate of lead to fifty gallons of water will control the pest and should be applied immediately on the appearance of the first injury. Unless natural enemies or thermal conditions interfere, both of the forest pests may be expected to recur this year.

House and Stable Flies.

More concerted effort and co-operation between the city and the country must be effected before the eradication of these disease-carrying insects can be possible.

Most all of the big cities have been waging relentless war against the house fly (Musca domestica), and while eradication has not been accomplished, much has been done in an educational way, particularly by "Fly-Swatting Contests" and public lectures.

The farm, however, still remains the undisputed stronghold of countless millions of the house-fly and stable flies, particularly Stomoxys calcitrans and the horn fly, Haematobia serrata.

In addition to the well-known disease-carrying propensities of the house-fly, it seems highly probable that science will shortly convict the stable fly of being the carrier of the dread infantile paralysis.

The chief breeding places of all three flies is in barnyard manure. The house fly breeds chiefly in fresh horse manure and the horn fly in moist cow manure. The stable fly will breed in any barnyard filth.

If the manure is kept in a tight box for two weeks many of the adults will perish, or if the manure is spread upon the fields each week, the drying and heating by the sun will kill the larvae and pupae.

Screening the houses and the keeping of small dishes of formalin and milk on the porches and around the stables will greatly aid in the control of the flies.

At the Experiment Station in July and August, the stable flies became so numerous that the herdsman had difficulty in milking.

To remedy this condition the cows were sprayed after each milking with Electro-Pine Tar Creosote. This seemed to afford the cows a degree of immunity from the attack of the flies. In addition, experiments were tried with two strengths of formalin in water, and three

strengths of formalin in skimmed milk. This was placed in shallow pans in the dairy barn.

It was found that one part of formalin (40 per cent. formaldehyde) to forty parts of skimmed milk was thoroughly effective in killing any flies that fed upon the mixture. Eight pans were used in the barn and approximately one quart of flies were swept up each morning. Most of these flies died in the immediate vicinity of the pans.

This method is equally effective in the home and on the porches. Its simplicity and cheapness readily recommend it.

It is urged that the farmers use means to prevent as far as possible the presence of these troublesome and dangerous pests in and around the house and farm buildings.

THE MARYLAND AGRICULTURAL EXPERIMENT STATION

BULLETIN No. 176. APRIL, 1913.

THE PEACH-TREE BORER.

Sanninoidea exitiosa, Say.

By E. N. Cory.

Introduction.

No other insect pest of the peach tree causes such widespread and serious injury as the Peach-tree Borer (S. exitiosa). Many growers wrongly attribute the destruction of their peach trees to causes other than the work of this pest. In many sections the "peach yellows" has decreased the productive life of the trees to a few years, hence the short life of trees injured by borers is frequently considered to be the natural life. This misapprehension, combined with negligence, allows for a rapid multiplication of the borers.

To estimate the exact amount of injury is a difficult task, especially in the small orchards where neglect of the borers usually means poor orchard management along every other line.

The actual damage done by the borers in girdling trees, while very great, is not the only injury occasioned. The incisions and tunnels increase the susceptibility of the trees to winter-killing, crown rot and possibly to "yellows."

In view of the extensive injury from the pest, work has been pursued to determine its life history, and, if possible, to discover an adequate means of protecting the peach-growing industry from its ravages.

The plan of the work naturally falls under two heads, viz.: observations on the life history and habits of the moths, and the testing of all the principal recommended or suggested preventative and remedial measures, together with such new methods as the writer has had opportunity to use.

The investigations of the life history and control measures have been prosecuted over a period of four years. The first work consisted of tests in the College orchards and at E. W. Hungerford's place, Marshall Hall, Md., of the principal methods of control then in vogue, together with such new methods as suggested themselves to Professor Symons, Mr. Peairs and the author. A full discussion of these tests follows on page 199.

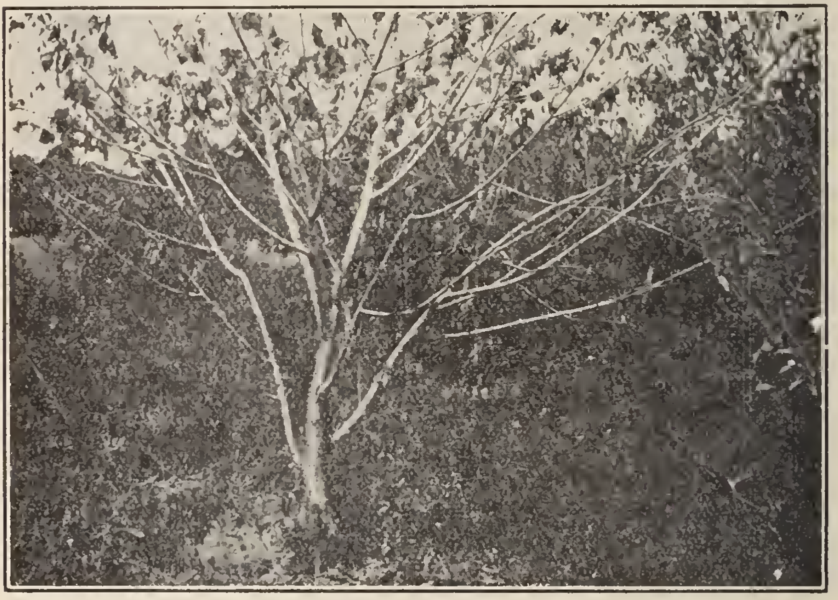


Fig. 1.—Young tree killed by borers.

In order to clearly establish some links in the life cycle special breeding work was undertaken. These studies related more directly to the fertilization, oviposition, and hatching of the egg, together with observations on the behavior of the first stage larva. In addition, an opportunity was afforded to study the efficiency of various insecticides on newly hatched larva.

Besides the special breeding work, collections of larvae, pupae and adults, together with field observations, were continued throughout the four years.

Early History of the Peach-Tree Borer.

The peach-tree borer has been known to horticulturists for over one hundred and fifty years, though the adults and their life history have not been known for nearly that length of time. The moth is a native of this country, and with the introduction of the peach tree to this country, assumed great economic importance as a pest of that tree.

The borer has been found breeding in plum, both wild and cultivated, as well as cherry, June berry, flowering almond, nectarine, apricot, azalea, peach trees and shrubs. For many years it was generally supposed that the native food was the wild plum, but experiments in grafting cultivated varieties of plums on native and Japan stock, by G. E. M., of Virginia, in 1896, show immunity of the former from the attack of the borers. This would seem to indicate that the native plum is not the original food plant of this pest. Probably wild cherry is the native food plant.

The earliest note on the injury by this pest is thought by Slingerland to be that made by Peter Kalm,* 1749, regarding the destruction of peach trees at Albany.

The adult seems to have been known as early as 1770, but it was not until 1804 that it received a scientific name. In that year Doctor Barton gave it the name of Zygaena persicae. The original description has not been found, hence Say's name, *Aegeria exitiosa,* 1823, stood until Beutenmuller erected the new genus *Sanninoidea,* using *exitiosa* as the type.

Various names have been given by different authors for this moth and it has even been described as a wasp.

Zygaena persicae, Barton, 1805.
Aegeria exitiosa, Say, 1823.
Apis persica, Thomas, 1824.
Paranthrene pepsidiformis, Hübner, 1825.
Aegeria persicae, Harris, 1826.

Sphinx exitiosa, Brown, 1832.
Trochilum exitiosum, Fitch, 1856.
Trochilum exitiosa, Morris, 1862.
Sesia xiphiaeformis, Boisduval, 1874.
Sannina exitiosa, Butler, 1874.
Sanninoidea exitiosa, Beütenmuller, 1896.

Three varieties have been described.
Aegeria exitiosa var. fitchii, 1882, Hy. Edward. Type, female.
Sannina exitiosa var. luminosa, 1894, Neumoegen. Type, male.
Sanninoidea exitiosa var. edwardsii, 1899, Beütenmuller. Type, female.

History of Control Measures.

Efforts to prevent or lessen the injuries occasioned by this pest have received the attention of orchardists and entomologists ever since 1871. In that year Cooper submitted a paper to the American Philosophical Society "On the Nature of the Worms So Prejudicial to the Peach Trees for Some Years Past and a Method for Preventing the Damage in Future."

*Bul. 170, Cornel. Agrl. Exp. Station.

Following this initial step scores of experimenters have used a great many ingenious methods to either prevent the oviposition, keep the young larvae out or to destroy the borers in their burrows. Wrappings of straw and wood, moundings, casings with sand in them, washes of many kinds, cultural methods, freezing, use of tobacco stems and "digging out" process have all been tried with many variations in the methods of application and the materials used.

Several men stand out in relief for the excellence of their work. One of these was Mr. Peters, in 1806. He tried straw and bass or paper bands, varying in height from six inches to four feet above the surface of the ground, white-washing, painting, urinous applications, brine, oil, tar, turpentine, sulfuric acid, nitrous mixtures, soot, lime, frames filled with sand, pavements of stone, mounding, scrubbing with brushes, soap suds and sand, hot suds, freezing and, in fact, nearly every kind of coating available at that time.

This work has been the basis for a great many experiments along the same lines. At various times some orchardist or entomologist has claimed to be able to control the pest. Usually such claims have proved to be based on insufficient experimental work or frequently in the case of orchardists who have used some wash in connection with the "worming process," the entire credit for the benefit derived from both treatments is given to the solution.

Often materials used for coating the trunk have been reported as giving good results in the hands of one man, but have totally failed of their purpose when applied by another. The same discrepancy in results often obtains for a solution when used in different parts of the country.

Probably the most thorough test of methods of control was made by the late Mr. Slingerland, of Cornell University, from 1892-1898.

From the many measures recommended about twenty-five were selected that seemed to hold out the greatest promise. These methods and materials were applied in an orchard of 400 trees planted especially for this work. Some of the materials were tested as long as four years while others were found to be worthless in a much shorter period. Slingerland used wire cages, tansy plants, asafetida and aloes, tallow, hard soap, whale oil soap, white-wash, white-wash and linseed oil, lime salt sulfur wash, resin wash, hydraulic cement and milk, pine tar, white paint, paris green and paint, paris green and glue, printer's ink, Raupenleim and Dandrolene. All were ineffective, and the last six were positively injurious. Of the other so-called remedies that were included in the tests, tobacco stems kept out two-thirds to five-sixths, mounding one-half to seven-tenths, tarred paper, one-half to seven-eighths, Hale's wash one-third to one-half, and gas tar four-fifths. He concludes that gas tar is the most effective wash and where used with discretion will not injure trees. "Digging out" or "worming" is, of course, effective.

Following his first work, Slingerland, in 1900, retested the effect of gas tar and the efficacy of the wooden and the wire protectors. These confirmatory tests were undertaken because J. M. Steadman, Ento-

mologist of Missouri, had secured diametrically opposite results from similar experiments. This work again showed the wire and wood protectors to be inefficient and the gas tar safe and efficient.

In 1897, the late Dr. J. B. Smith, Entomologist of New Jersey, conducted some experiments with eight different protectors and in 1898, published a bulletin, No. 128, with the double title: The Peach Borer—Experiments with Hydraulic Cement. This bulletin is one of the most comprehensive studies we have of the insect and its control. Especial emphasis is laid on the value of newspaper protectors and the hydraulic cement and milk mixture.

However, Dr. Smith has found it necessary in Bulletin 235 to make other recommendations, presumably after having given his previous treatment a more extended test. His latest recommendation is late fall and early spring "worming," the latter followed by spraying the exposed crowns and trunks with lime-sulfur and arsenate of lead, with an excess of lime added.

The experience of Dr. Smith is very similar to that of others who have worked along the same lines and is expressed by Mr. Peters thus: "I have, for a season or two under various experiments, amused myself with the persuasion that I had discovered an infallible panacea. I had temporary success, but final disappointment."

Mr. H. N. Starnes, 1906, prepared an excellent bulletin, No. 73, of the Georgia Experiment Station, in which he corrected some mistaken ideas concerning the seasonal history of S. exitiosa in the South. He recommends worming and mounding and the use of lime and caustic potash.

The most recent work has been done by Mr. E. L. Morris, of the California Station, Bulletin 228, published in 1912. Hard asphaltum of the grades C. and D. were used. "It was found that a thick, heavy coating prevented both the issuance and entrance of about 95 per cent to 98 per cent of the insects, the degree of efficiency depending upon the thoroughness of the application." However, their recommendations are as follows: "In the fall throw the soil away from the trees and *dig borers*. In the spring *dig the borers again* and apply a thin coating of asphaltum and replace the soil. Examine the trees each subsequent year *to remove borers* and to repair any thin or broken places in the asphaltum coating."

The major portion of the work has been along the beaten path started by Peters. The bibliography of the literature on S. exitiosa includes over 200 titles.

Biological Studies.

In order that exact records of the activities of the moths might be secured, three special cages were built. These were made of wooden frames covered with wire cloth, of mesh small enough to keep out most insects, and were provided with doors so that a man could work within the enclosure. Two cages were four feet square at the base, and six feet high, while the third was five feet square at the base and eight feet high. (See figures 2 and 3.)

The cages were placed over two-year-old nursery trees, known to be free from the borer or eggs.

For some time before larvae and pupae had been collected in order to obtain virgin females. One of these, together with a male moth, was placed in each cage to breed. Following is a detailed account of these breeding experiments, exclusive of the data obtained from collection.

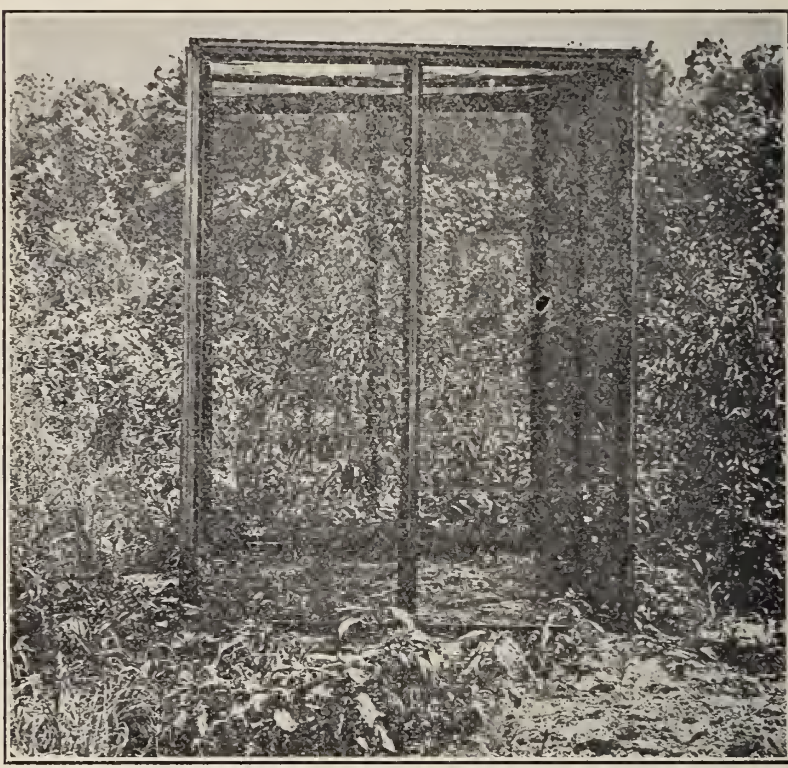


Fig. 2.—A breeding cage over nursery stock.

Notes on the Egg-Laying Habits.

The cages were erected in the field on June 22, 1910, but it was not until July 11 that observations were recorded.

Records:—

Female No. 1, July 11.—At 8.30 A. M., one male and one female moth, number one, reared in confinement, were introduced into cage A. At 9.45 A. M., two more males, reared in confinement, were intro-

duced. No attempt at copulation was made by these males. At 10.10 A. M., one male was observed flying around the outside of the cage near the female, who was resting on the wire with the tip of her abdomen elevated and genitalia protruded. This male was captured and introduced into the cage. He flew at once to the female and copulation began at 10.13 A. M., the pair remaining in coitu until 11.05 A. M. They settled on one of the uprights, with heads in opposite directions.

July 12.—All moths caged on July 11 escaped from cage A, owing to a screw pulling loose. This was remedied.

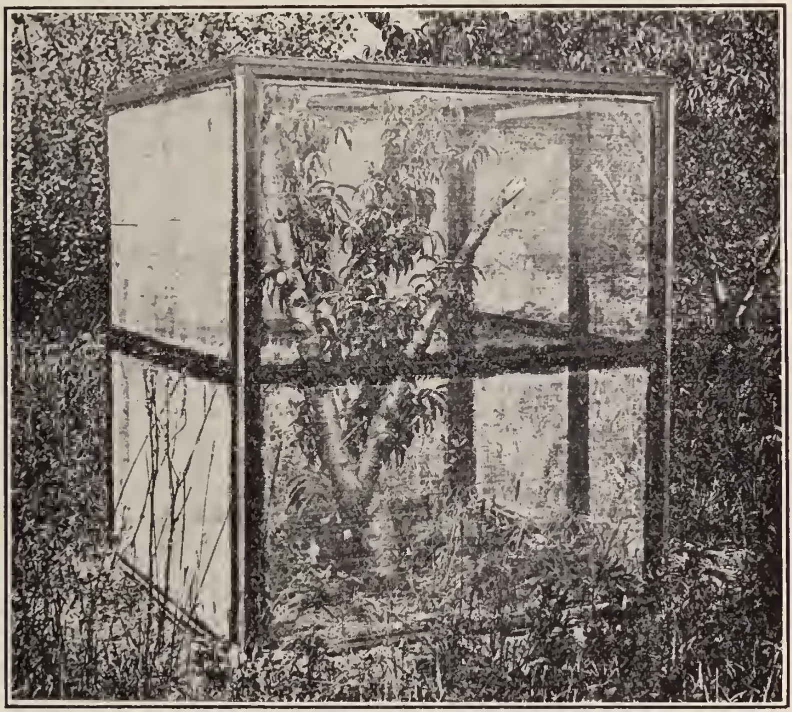


Fig. 3.—A breeding cage over large tree.

Female No. 2, July 12.—At 11.15 A. M., four males and one female, number two, reared in the insectary, were placed in cage A. By 12.15 P. M., four males had visited the cage. Three of these were caught and put into the cage. The female during this time had her abdomen curved upward and the genitalia extended. At 12.23 P. M., copulation took place, but whether with one of the males reared or one of the visitors, could not be determined. The female remained stationary as before, the male hovering near until finally able to clasp the female.

The two triangular tufts of hairs on the male's abdomen apparently clasped the female along the sides of the abdomen and the anal tuft of the male was above the tip of the abdomen of the female. They remained in coitu until 1.23 P. M., male head down.

July 13.—From 6.30 to 9 A. M., female number two was sluggish and in the grass; from 9 to 11 A. M., she was on the wire of the cage and from 11 A. M. to 3.10 P. M., she was on the peach foliage. At 1.45 she began to swing gently the tip of her abdomen, with ovipositor extended, from side to side, occasionally touching the leaf on which she stood. At 1.56 she deposited her first egg; at 2.09, the second; the third at 2.15 and the fourth at 2.22. She then ceased ovipositing for the day. One male left overnight in the cage.

July 14.—At 11.29 A. M., the female number two was resting on leaves, genitalia exserted, and one male appeared, which was captured and introduced. At 11.39 a second male appeared at the cage. At 11.51 two more males came to the cage; at the same time the female deposited one egg. At 11.53 one male was allowed to enter the cage and he immediately copulated with female number two, remaining in coitu until 12.44. At 12.46 the female began ovipositing, laying five eggs by 1.01. The remainder of the day she rested on the side of the cage.

July 15.—Female number two alive at 8 A. M., resting on ground. At 2.30 P. M. she was dead. She deposited twenty-one eggs on the peach leaves. Quite a mass of eggs were in the body, which was mutilated by ants.

One female, number three, emerged between 9 and 11 A. M., and was placed in cage B, surrounding four trees, at 11 A. M. At 11.45 she took up a position on a side of the cage, raised her abdomen and extended her genitalia. At 11.56 one male appeared; failed to catch same. At 12.01 P. M., two males appeared; one was caught and placed in cage. At 12.04 another male appeared, was caught and placed in the cage; at 12.06 a fourth male and at 12.15 a fifth; neither was caught. At 12.17 female number three copulated with one of the males, remaining in coitu for an hour. At 1.30 the female began ovipositing, two eggs being delivered between 1.30 and 1.40. She then ceased ovipositing for the day. In copulating the male flew at the female, waiting with abdomen elevated and genitalia extended, and repeatedly darted the tip of his abdomen at the female, finally joining and turning. The female retained her hold on the cage; the male vibrating its wings rapidly for a time, finally settling on the cage, head down.

July 14.—Three males left overnight in cage B. Flight of female heavy. At 3 P. M., female number three began ovipositing again.

July 18.—Female number three gone, presumably dead and eaten by ants during the night. She deposited 21, 30, 25 and 85 eggs, respectively on the four trees. Largest number of eggs in one cluster 9; largest number on one leaf 12.

These results were contrary to any account of the egg-laying habits that the writer had seen and, believing that they might be influenced by the artificial conditions, another condition was supplied in this manner. A peach tree about 10 years old, having plenty of foliage and a heavy trunk, was cut back to permit one of the cages to be placed over the tree. This then approximated natural conditions in every way, except that the moth, number four, was in confinement. Fig. 3.

July 27.—All eggs hatched in cage B. The hatching occurred either during the night or very early morning and was not observed, the larvae emerged from the micropyle end, cutting out the entire end in small sawdust-like particles. Cage B was then moved over four other trees.

Female No. 4, July 25.—At 9 A. M., two females, numbers four and five, and one male, were put in cage C. At 9.55 two males were flying about the cage, one of which was caught and introduced; at 10.15 a second visiting male was placed in the cage and at 10.22 a third was secured. At 10.24 one pair was in coitu, remaining on the branches and leaves until 11.45, when they separated. At this time female number five, not having copulated, was removed from the cage. In this case, as before, the males appeared only when the female extended her ovipositor, flying away when she sheathed same. At 1 P. M. two eggs were found on a bark scale just above the ground and one egg about 18 inches above.

July 26.—Female number four not in the cage, presumably died and was eaten by ants. She deposited fifty-six eggs on the leaves and twenty-three on the trunk. Female number five not used further in these tests.

August 4.—Seven eggs in cage C hatched between 4.30 P. M., August 3rd and 7.30 A. M., August 4th. Larvae could not be found, even with a large reading glass.

August 5.—Cage C was carefully watched until dark on the 4th, but on visiting the cage at 7.30 on this date, all eggs were hatched

Female No. 5.—This moth was not used.

Female No. 6, July 27.—At 1.30 one female, number six, was introduced into cage B with one male. At 2.10 one male appeared; at 2.15 one male was introduced; at 2.45 another male was introduced, and at 2.50 a fourth male was placed in the cage. No copulation.

July 28.—At 11.00 and 11.30 males were placed in cage B. At 11.40 a pair were in coitu, separating at 1 P. M.

July 29.—Forty-two eggs on the trunk of one tree in cage B, the first egg eight inches from the ground; last about eighteen inches. Sixteen eggs were found on the leaves.

August 1.—Female dead. She deposited a total of ninety-seven eggs, forty-two of which were on the trunk and fifty-five on the leaves.

August 1.—Eggs on trunk of tree in cage B had their top half eaten off. A coccinellid (*M. maculata*) found in this cage was brought into the laboratory and placed in a cage with leaves having eggs of *S. exitiosa* on them. The beetle did not feed on any of the eggs.

August 1.—Nine more eggs in cage B eaten. No insect found that could have done the damage.

August 9.—Two eggs in cage B hatched during the time between sunset and 8 A. M. the following morning.

August 10.—All remaining eggs in cage B hatched during the interval between sunset and 8 A. M.

Female No. 7, July 28.—Female number seven placed in cage A at 10.05 and males placed with her at 11.00, 11.25 and 11.45.
July 29.—Twenty-one eggs found in cage A.

August 1.—Female number seven dead. She deposited 75 eggs, 47 of which were on the tip of one leaf, overlapping both sides.
August 13.—No eggs in cage A hatched.

Female No. 8, September 10.—Owing to the fact that no more moths emerged in the insectary, work was discontinued, but on this date two females emerged from the old tree in cage C and on August 12 number eight was transferred to cage A. The other was held in reserve.

September 12.—One female placed in cage A. At 12.00 a visiting moth was introduced into the cage and at 12.06 copulation took place, lasting an hour.

September 13.—Twenty-two eggs deposited by female. She afterwards became entangled in a spider web and died.

September 29.—All eggs in cage A hatched between 6 P. M., September 28, and 9.30 A. M., September 29.

Summary.

In all cases, the males appeared only when the females exserted their genitalia and it was notable that the former came to the cages almost immediately following the protrusion of the ovipositor. As far as could be ascertained, no sound was produced by the female. In all cases except one, only the captured visiting males copulated with the females. In the exception noted, so many males were in the cage that this point could not be determined.

In copulating the females rested on the cage or leaves, with genitalia exserted; the male hovered near, darting the tip of its abdomen toward the female until finally able to clasp her genitalia. He then turned with his head in the opposite direction to hers and settled on the same object that supported the female. The shortest period of copulation was fifty-one minutes; the longest eighty-one minutes and the average

sixty-five minutes and forty-five seconds. However, in one case the female was fertilized twice, the day she was introduced and the succeeding day. The time between the fertilization and oviposition varied

Fig. 4.—Moth ovipositing on leaf.

between wide limits and the latter was not always continuous. In some cases the females oviposited within a few minutes of fertilization, and again the interval was over twenty-four hours.

During oviposition the female arched the center of her abdomen upward, the tip pointing downward and extended the ovipositor. Then she began to swing her abdomen gently, from side to side, occasionally pausing to touch her ovipositor to the leaf. Each egg was deposited singly and glued to the leaf by a secretion placed on the leaf before delivery of the egg. The eggs are brown, regularly oval, and average .823 mm. x .542 mm. The micropyle end is heavily indented. The shell is net-veined. Fig. 5 shows the eggs, natural size, on the leaf, Fig. 6 enlarged. The greatest number of eggs deposited by one moth

was 161. The greatest number in one place 47. Of all eggs deposited 390 were placed on the leaves and 65 on the trunk. The shortest period of incubation was 10 days; the longest 16½ days (in Septem-

Fig. 5.—The eggs natural size on peach leaf.

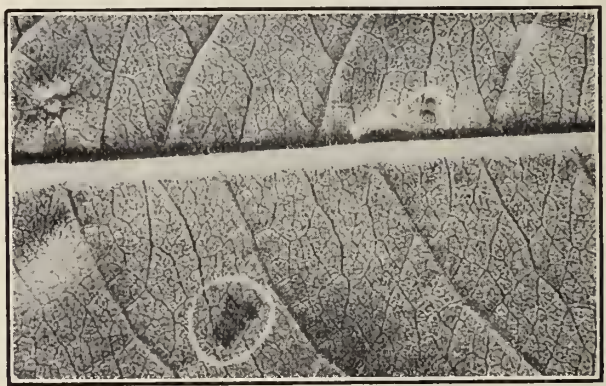


Fig. 6.—The eggs enlarged.

ber) and the average 13 days. All larvae emerged from the micropyle end, cutting it away in small sawdust-like particles.

The Larvae.

Newly hatched larvae are .6466 mm. in length and have the same general appearance as the mature larvae.

In this work the eggs usually hatched either at night or very early in the morning, so that at no time was the actual hatching observed in the field. However, the hatching was observed in the laboratory under somewhat artificial conditions.

Eggs from cage C, deposited Aug. 12th, 1911, on leaves, were brought into the laboratory with the twig on August 24th. This was placed in water and carefully watched. Early on the morning of August 25th, seven of the eleven eggs hatched, the larvae cutting out the micropyle end and either crawling down the stem or dropping. These were then replaced on the leaves and again watched. After moving about on the leaves for a time they again dropped or crawled down the stem. Two crawled down the stem to every one that dropped, but none spun a web to lower itself with, as they are commonly reported to do. The larva at this time is exceedingly minute, being difficult to follow, even with a large reading glass. All seven larvae dropped or crawled into the water in which the twig was kept, but after being removed with a brush seemed to show no ill effects and indeed displayed remarkable vitality.

Several of these larvae were then placed on a peach tree trunk and observed for several hours. They crawled about slowly, apparently seeking a suitable place to enter, but not finding a place to their liking, finally fell off into the dust and perished.

The larva leaves a small amount of fine frass to mark the opening where it enters, but this soon blows off, so that until the gum begins to exude the point of entry is exceedingly difficult to find.

The borers feed all summer, usually in the cambium, making a somewhat tortuous channel. In the fall they go deeper into the trunk and work down below the ground level. Many eggs are infertile or are destroyed by predaceous or parasitic insects and of the larvae actually produced only a small percentage reach maturity.

Quite a large percentage of the borers enter the trunk at a considerable distance from the ground. Rarely do these reach maturity, possibly due to thermal extremes.

Those entering near the ground burrow downward, wintering in their tunnels below the earth's surface. During open weather in the winter, the larvae feed to some extent and with the approach of warm weather resume active life.

The mature larva averages 28.5 mm. in length. The general color is light yellow or white, head shining brown and the dorsal shields of

the first thoracic and last abdominal segments light brown. The body is lightly pubescent, the hairs arising from tubercles. The mandibles are strong and black. The spiracles are brown. There are five pairs of prolegs provided with brown hooklets.

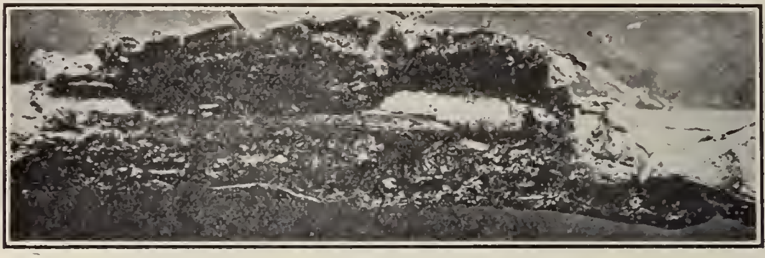


Fig. 7.—The larva in its burrow in a root.

The small white thread-like worms frequently seen in the gum are dipterous larvae, and do no damage to the tree.

The Pupa.

The earliest record of pupation secured showed that larva collected on May 31st, 1910, pupated June 1st. However, the maximum pupation occurs at a later date, the greatest number pupating from July 1st up to the middle of August. Seasonal conditions govern the date of pupation to a great extent.

Fig. 8.—Cocoon and empty pupal skin, showing depth beneath soil surface.

The larva usually constructs a cocoon in the earth just outside the burrow, but in cases where there is a large opening of the tunnel at or near the earth level, the pupa case is often formed just within the entrance. Seldom is the cocoon more than one inch below the surface of the earth.

The case is made of silk covered on the outside with bits of wood and frass.

Fig. 9.—Pupa case and cocoon (enlarged). Peairs.

Fig. 10.—Empty pupal case in young tree.

The pupa is a light brown at first, gradually changing to a rich dark brown as the time of emergence of the adult approaches. The pupa has a row of spines directed caudad on the posterior margin of the dorsal surface of each abdominal segment. The male pupa is smaller than the female. They average 25 mm. in length.

The pupal state averages 22-23 days in duration, during the height of the season, being somewhat longer in the case of early and late pupating individuals. Of those that pupated June 1st, 1910, the first male appeared on July 3rd, the first female July 7th. Larvae that pupated June 16th, 1910, produced both males and females on July 11, 1910, a period of 25 days. In one case an infested tree trunk was brought into the laboratory in late fall, 1908, from which a male moth issued on December 9, 1909.

Emergence of a Moth.

On entering the insectary at 8.30 A. M., July 21, 1910, one pupa, collected on July 20, was found half above ground in the flower pot in which it had been placed. Taken into the sunlight at 9 A. M., it began, after a few minutes, to twist on the tip of its abdomen as a pivot until about three-fourths above ground. After a short rest the insect began pushing upwards by successive contractions and expansions of the abdominal segments until the pupa case split along the back a short distance and down the front between the wing and antennae cases Continuing the motion, the insect gradually withdrew its body. The antennae and proboscis cases split on their inner side, i. e., the side next to the body.

The adult proved to be a male. It rested on a lump of dirt with wings against its sides for several minutes. The wings were then opaque. Gradually it arched the anterior wings, separating them from the posterior pair. After having separated them it lowered the anterior pair until in contact with the posterior wings and then raised both sets until their upper surface rested above the back. They were held in this posititon about five minutes, the opaqueness gradually clearing and the vein becoming outlined with yellow. After five minutes the wings were lowered to the body with the costal margin of the anterior wing at about 45 degrees to the body, in a horizontal plane. After ten minutes in this position the moth was ready for flight.

The Adult Moths.

The adult male moth is about 17 mm. in length, and 30 mm. in wing expanse. The general color is steel blue or blue black. This is relieved by yellow scales between the eyes, on the posterior margin of each abdominal segment, bordering the anal tufts, at the apices of the femorae and tibiae and on the costal margin of the hind wings. Both pair of wings are clear of scales except for a narrow black band across the outer third of the fore wings. In all collections the author has made, the male sex greatly predominated.

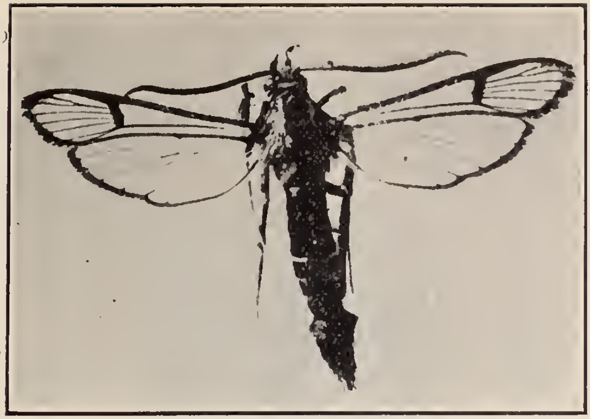


Fig. 11.—Male moth (enlarged).

Fig. 2.—Male moth (natural size).

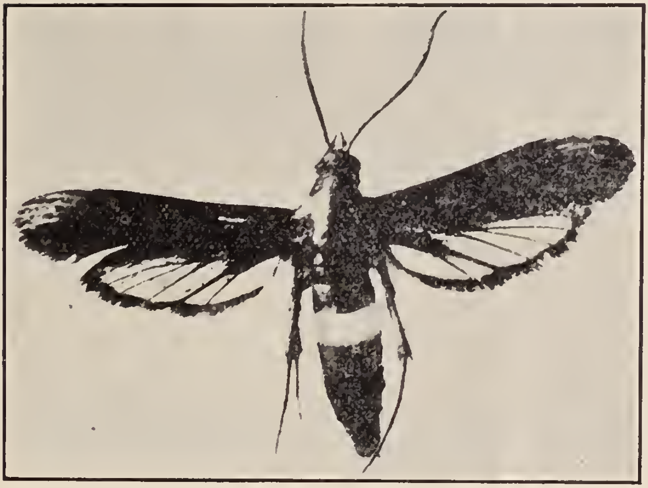


Fig. 13.—Female moth (enlarged).

The female is about 19 mm. in length and 34 mm. in wing expanse. The appearance of the female is totally at variance with the male. The general color is irridescent black, except for an orange band which covers the whole of the fourth abdominal segment. The hind wings only are clear. In one variety the space between the two inner veins of the hind wing is clothed with scales. The resemblance to hymenoptera in both sexes is marked.

Fig. 14.—Female moth (natural size).

In the mornings of bright, sunny days the adult females can be seen flying in a badly infested orchard, the flight being slow and circling. On the contrary, the flight of a male moth is rapid, so that to identify one on the wing is nearly impossible.

Natural Enemies.

No records were secured of the predaceous enemies, though in several cases eggs were destroyed in such a manner as to indicate their destruction by such an agency. Parasites were reared from eggs deposited in cage B on August 21st, 1911. These were determined as Telenomus quaintancei, Gir. One female parasite was captured on the egg mass apparently in the act of ovipositing. The egg mass of 32 eggs was brought into the laboratory and the parasites bred out by A. B. Gahan, who gives the following data concerning them:

"Five parasites emerged from the egg mass on September 9, 1911, indicating that the development from egg to adult covers a period of about 19 days. While not conclusive, it is reasonable to suppose that the bred specimens are the product of eggs laid by the above mentioned female before she was captured. This is of importance as showing the opportunity for a number of generations of the parasite during the normal egg-laying period of the moth."

Two parasites have been bred from the pupae. These are quite common apparently, and are possibly a considerable factor in reducing the number of moths. One of these parasites has been identified as Bracon sp., while the other is apparently Macrodyctium sp.

An undetermined fungus parasite also largely increases the mortality of the pupae.

Studies of Control Measures.

In 1908 a series of tests to determine the efficiency of various control measures were instituted in the College orchard. The trees used were about twelve years old and had been badly infested with borers at many stages during their existence. These were carefully "wormed" in June and applications of Tanglefoot were made on six trees from three inches below ground up to twelve inches on the trunk. On six more, protectors of Rubberoid roofing paper were tacked tightly around the tree about twelve inches above ground, and extended in cone shape to three inches below the surface, with the earth mounded around them Sheathing paper was used on six trees in the same manner and on six more newspapers were tied.

Examination in the fall and following spring revealed larvae in all of the treated trees and their small size in the fall would seem to indicate that they were of that summer's brood. Moreover, the trees treated with Tanglefoot showed considerable injury to the bark, in that the outer layer had been killed. The Rubberoid lasted the full season, but the other two papers were too light to last throughout the summer.

In the spring of 1909, E. W. Hungerford, Marshall Hall, Md., planted an orchard of one-year peach trees in sandy loam. He very kindly allowed this Department to conduct a series of tests designed to keep out borers. Mr. Peairs, assisted by the author, applied these tests on June 29th, July 1st and July 10th.

The following list shows the nature of each test and its number, which occurs again on the plat given further on. Each square in the plat represents one tree and the number therein shows by reference to the list what treatment was applied.

June 29th and July 1st, 1909.

1. Tobacco dust put at base of tree and the earth mounded to a height of six inches.
2. Tobacco dust at base of tree and newspaper protectors above ground.
3. Pyroligneous acid (condensed smoke) painted on trunks.
4. Apterite put at base of trees and earth mounded as in test 1.
5. White lead and linseed oil painted on trunks.
6. Commercial lime-sulfur 1-9 painted on trunks.
7. Carbolic fertilizer used as in test 1.
8. Mounds of earth only.
9. Gas tar painted on trunks.
10. Quaintance Wash painted on trunks.
11. Hale's Wash painted on trunks.
12. Tar paper protectors.
13. Newspaper protectors.
14. Newspaper protectors tied on and mounded.
15. Wood veneer protectors tied on and mounded.
16. Wire gauze protectors tacked on and mounded.
17. Checks untreated.

1x. Tobacco dust repeated.
1xx. Tobacco dust on two-year-old trees, previously untreated.
13x. Newspapers repeated.

Row No.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV
		1 1x	3	3	4	5	6	6	7	9	10	10	11	12	12	13 13x	14	8	8	15	15	16	17	17
	1xx	1 1x	3	3	4	5	6	6	7	9	10	10	11	12	12	13 13x	14	8	8	15	15	16	17	17
	1xx	1 1x	3	4	4	5	6	6	7	9	10	10	11	12	12	13 13x	14	8	8	15	15	16	17	17
	1xx	1 1x	3	4	4	5	6	6	7	9	10	10	11	12	12	13 13x	14	8	8	15	15	16	17	17
		1	2	4	4	5	6	6	7	7	10	10	11	12	12	13 13x	14	8	8	15	15	16	17	17
		1	2	4	4	5	6	6	7	7	10	10	11	12	12	13 13x	14	8	8	15	15	16	17	17
		1	1	4	4	5	6	6	7	7	10	10	11	12	12	13	14	8	8	15	15	16	17	17

Each square in the plat represents one tree and the number therein shows by reference to the list what treatment was applied.

Notes on the Material.

4. Apterite is the trade name for a purple powder made by the William Cooper and Nephews Co., manufacturers of sheep dips. This material has a strong odor of carbolic acid.

9. Gas tar purchased in Washington, D. C.

10. Quaintance Wash (?) was made from glue, builders' hair and lime.

11. Hale's Wash (modified).

These trees, known to be free from borers, afforded an excellent opportunity to test the efficacy of the various treatments. Numerous visits were made to the orchard to ascertain the general condition of the tests, and on July 28th, it was observed that the trees in row XIII treated with Hale's Wash had been killed by the application. This wash was made by using two quarts whale oil soap (soft) one-half pint crude carbolic acid, two ounces of Paris Green, three gallons of water and sufficient lime to make a thick paint.

These trees were carefully examined on July 14th, 1910, with results as set forth below.

1. No borers.
2. Borers in 1.
3. Borers as plentiful as in checks.
4. Borers in two trees and bad galls had formed at the crowns.
5. Borers in 2.
6. Two borers in six trees.
7. One borer.
8. Three borers.
9. One borer in four trees.
10. One borer.
11. Trees dead.
12. No borers in two trees.
13. No borers.
14. Two borers.
15. Veneer split and valueless before summer was over, so trees not carefully examined.
16. Wire rusted, so results as above, a few trees examined in each case showed borers.

About the time the above observations were made, the author had secured enough data in regard to the egg-laying habits to indicate that any method or material designed to prevent the oviposition of borers was futile, since the moths will oviposit on leaves, twigs or trunk. However, on July 29th the tobacco dust treatment and the newspaper wrappings were renewed and three trees in row 1 not previously treated were treated with tobacco dust. On examination in the fall of 1910, and again in 1911, these latter treatments were found to be inefficient.

The breeding work was undertaken with a view of obtaining exact biological data. It was not supposed that such studies would shed any new light on the economic phase of the situation, but the discovery of the method of oviposition showed to our satisfaction that the methods heretofore pursued in combatting this pest were misdirected efforts Hence, the work at Marshall Hall was abandoned and efforts were made to discover a coating that would *kill* newly hatched larvae, should they partake of the material in entering the bark.

For this work the breeding cages were placed over trees known to be borer free and a pair of moths liberated therein. Records were kept of the date of laying of the eggs, so that just prior to hatching a protective coating could be applied to the tree or trees within the enclosure. Thus, accurate records could be obtained of the effectiveness of the washes in preventing the entrance of the larvae.

The following mixtures were used over a period of two years:

1. Concentrated lime-sulfur.
2. Arsenate of lead paste.
3. Fish oil soap-rosin.
4. Fish oil soap-rosin and arsenate of lead.
5. Powdered arsenate of lead, white lead and linseed oil.
6. Lead chromate, white lead and linseed oil.
7. Atomic sulfur and arsenite of zinc.
8. Arsenate of lead paste with "Tree Sticky" painted on over top.
9. Arsenate of lead paste and "Tree Sticky" mixed.
10. "Tree Sticky."

All of the preparations failed to keep the borers from entering the tree or were so harmful to the trees that their use cannot be recommended.

Concentrated lime-sulfur and the fish-oil soap were the only materials that did not injure the trees. However, to be effective, applications would have to be made about one week apart (obviously an impossible orchard practice), due to the fact that minute cracks appear almost daily during a good growing season.

The other materials injured the bark to a more or less considerable extent, as shown by a blackening of the tissues or by gummosis.

Atomic sulfur and arsenite of zinc (specially prepared for codling moth work) killed outright the four trees treated with it.

On August 26th, 1911, 500 three-year-old peach trees in an orchard at Muirkirk, Maryland, were carefully wormed and left exposed for two days. They were then treated with lime-sulfur 1-9, to every five gallons of which was added one pound of arsenate of lead paste. The earth was then returned about the trees.

On May 31st, 1912, an examination was made of the trees that showed as high as five borers in some trees and very few trees entirely free from the borers. It is possible, of course, that some borers were overlooked in the worming, the previous season, but there were so many more partially grown larvae than fully developed larvae at the last inspection, that the results would seem to indicate that the lime-

sulfur arsenate of lead wash was ineffective. Some little injury to the bark was noted.

On June 15th, 1912, several trees at Marshall Hall were treated with Electro Pine Tar Creosote. The earth was removed from the base and the burrows of the larvae were exposed. In several burrows there were pupae. A coating of pine tar creosote was applied and allowed to run into the channels. One pupa in one tree and two in another failed to emerge. This indicated that the material may prove efficient in killing larvae or pupae within the burrow. The work with this material was not continued for lack of data on the probable effect of the creosote on the life of the tree. Later observations indicate the material to be safe.

Summary of the Control Measures.

A.—*Cultural Treatments*:

1. Tobacco dust and earth mounds gave immunity for the first year, but on trial the second year failed to keep out the worms.

2. Carbolic fertilizer and earth mounds gave poor results in one year's trial, so was not continued.

3. Apterite and earth mounds did not give good results in that the material not only did not keep out the borers, but it also caused the formation of collar galls.

B.—*Mechanical Barriers and Repellants*:

1. Tanglefoot has never proved of value in any tests we have made and has always injured the bark to a considerable extent, the injury depending upon the age of the tree. Theoretically, it is an ideal barrier.

2. Tanglefoot and arsenate of lead is more injurious to the bark than Tanglefoot alone.

3. Gas tar has been highly recommended by various workers, but has never proved successful in our work and has injured the trees to some extent. We could not recommend its use on young trees.

4. Pyroligneous acid, in addition to proving ineffective in keeping out borers, will very likely prove too expensive for large plantings.

5, 6 and 7. Rubberoid roofing paper, sheathing paper and newspapers have not proved effective barriers, primarily because of the difficulty in making the union between the wrapping and the tree tight enough to prevent the entrance of the larvae. Should the above purpose be effected the probable outcome would be that the larvae would enter above the wrapping. The work of attaching protectors of any kind is a considerable item of expense.

8. Wire protectors rust out quickly, are expensive and do not protect.

9. Wood veneer cracks and warps and a tight union is an impossibility; it is ineffective in keeping out borers.

10. White lead and linseed oil has injured the bark on some of our trees and cannot be depended on to prevent the entrance of the larvae.

11. White lead, linseed oil and arsenate of lead is unsatisfactory, as it injures the bark to an appreciable extent. It does not prevent the entrance of borers.

12. White lead, linseed oil and lead chromate presents the same difficulties as the foregoing. All paint mixtures caused a blackening of the outer bark and gummosis, in addition to the fact that they were ineffective in keeping out borers.

13. Concentrated lime-sulfur (commercial brand) has been highly recommended at various times, but in the author's experience with it on young trees it has not proved effective in keeping out the borers. The practice of spraying the crowns after the "worming" to prevent fungus trouble is a good one.

14. Concentrated lime-sulfur and arsenate of lead. The addition of arsenate of lead apparently does not add to the effectiveness of the material.

15. Atomic sulfur and arsenite of zinc killed the trees on which it was applied and hence cannot be too strongly condemned.

16. Hale's Wash also killed the trees on which it was applied—strongly condemned.

17. Quaintance wash proved ineffective and undesirable from a laborer's standpoint.

18. Arsenate of lead scales off too quickly to be effective.

20. Fish Oil Soap-Rosin. This material is not lasting enough nor is it effective for even a short period.

21. Fish Oil Soap and arsenate of lead. This material, besides being too easily washed off, caused gummosis, probably due to the arsenical.

General Remarks.

Owing to the habits of oviposition of the moths, mechanical barriers cannot be recommended.

Repellant washes that depend upon their odor for their effect are useless.

Coating intended to present physical difficulties to the entrance of the larvae are ineffective because the tree growth and weathering produces cracks in which the borers can enter. Frequent coatings to obviate this difficulty are often dangerous to the health of the tree and are moreover too costly.

Poison coating with other ingredients used to make them last longer are usually deleterious to the health of the trees.

Poison coatings alone are too readily washed off.

Materials used at the tree base as repellants are ineffective and in some cases dangerous.

Mounds of earth have proved to be the best practice that can be recommended. While mounds are not effective in keeping out the borers, they will cause the larvae to enter at a higher point than normally would be the case. This facilitates the removal of the larvae, rendering the cost less.

Worming is certainly effective, and when done by careful workers need not injure the trees to any appreciable extent. This should be done with a sharp knife and a light wire with a small hook turned on

the point. With this the larva can often be drawn from the burrow without much injury to the tree. A triangular scraper will be found of great aid in "worming."

RECOMMENDATIONS.

"Worm" the trees as late in fall as practicable before cold weather and again in May. In order to facilitate the work, have the earth drawn away from the trunks to a depth of six inches and the crowns scraped at least one day before the "worming" is begun. Do not leave the crowns exposed longer than necessary. Mound the earth around the tree to a height of six inches.

BIBLIOGRAPHY.*

1749.—Kalm, P. Travels in North America. Trans. by Forster, II., 244. Apparently the first reference to the insect.

1771.—Cooper, J. Submitted a paper to Am. Phil. Soc., on "The Nature of the Worms so Prejudicial to the Peach-Trees for Some Years Past, and a Method for Preventing the Damage in Future." The Society ordered the paper to be printed in the Pennsylvania Gazette and Journal.

1801.—Ellis, J. Papers on Agr., Mass. Agr. Soc., p. 25, 26; same account in Mass. Agr. Soc. Papers for 1803, and in Trans. Am. Phil. Soc., V., 325. Brief and fairly correct account submitted as Prize Essay ($30.00 prize) some time before 1800 to Am. Phil. Society. Recommends binding on straw when trees are in bloom, removing it in the fall.

1802.—Barton, B. S. Philosophical Mag., XXII., 208 (pub. in 1805). Footnote as follows: "The insects most pernicious to this tree are two lepidopterous insects, of the genus zygaena of Farbricius. These while in the larva state, destroy the bark of the root." Partly quoted by Kirby and Spence in their Introduction to Entomology, I., 198 (1815).

1803.—Mease, J. Domestic Encyclopaedia, IV., 243-244. Brief account. Recommends mounding, soap-suds, and quotes Ellis.

1804. Barton, B. S. Essay on "A Number of the Pernicious Insects of the United States," submitted to the Am. Phil. Soc. It was partly read on November 16, 1804, and received the Magellanic Premium on December 21, 1804. The essay was returned for alterations in 1805, and we are unable to find that it was ever published. It is recorded (Harris in 1826) that the insect was described and given its

*Free use has been made of the excellent bibliographies of Slingerland, Starnes and Beutenmuller.

first scientific name of Zygaena persicae in this apparently unpublished essay.

1805. Barton, B. S., Phil. Med. and Physical Journal, I., pt. II, p. 29. Brief notice as being destructive to roots of peach. No description of moth.

1808. Cooper, J. Mem. Phila. Soc. Prom. Agr., I, 11-14. (Paper read Jan. 14, 1806). Brief, but very good account of the life-history and methods of controlling the insect. The "freezing out" process unsuccessful. A combination of the "digging out" and "mounding" methods was very successful.

Peters, R. Mem. Phila. Soc. Prom. Agr., I, 15-19. (Paper read Feb. 11, 1806). Records failure to prevent the work of the borers by the use of 25 or more different "washes" and other methods. Recommends exposing roots in winter and using boiling hot soap-suds or water in August or September.

Matlack, T. Mem. Phila. Soc. Prom. Agr. I., 273-279. Supposed there were two broods of the borers. Detailed account of successful use of sand (not loam) in earthen cylinder or in a pile around base of tree.

1813.—Cocke, J. H. Mease's Archives of Useful Knowledge, III., 40-42. Same account in American Farmer (1820) I., 350. Good brief account of life-history. Failed with straw, but was very successful with tobacco leaves.

1820.—"W. T." (Wash., D. C.) The Plough Boy, I., 331. Brief account of life-history. Counted 678 eggs in one female.

1822. Thacher, J. American Orchardist, 198. Brief account quoted from Mease (1803).

1823. Say, T. Jour. Acad. Nat. Sci., Phila., III, 216. Original description of moth as *aegeria exitiosa*. Pupa and cocoon described.

Worth, J. Jour. Acad. Nat. Sci., Phila., III, 217-221. Very good account of the life-history of the insect; egg first described. A sensible discussion of methods then recommended. Recommends a bandage of tow followed by a soft soap or lime-wash. Same account in American Farmer, IV., 395; and also in Mem. Bd. of Agr. of New York, III., (1826), p. 421.

"Agricola" (N. Car). American Farmer, V., 118. Brief account of life-history, thought moths perforated bark to lay eggs. Quotes Tilton's experience with hot water, and also the recommendations of Peters, Coxe and Cocke.

Harris, T. W. Letters to Say and replies published in Psyche, VI., 58, 60, 122, 123-124 (1891). Brief notice; proposed to call it *persicae*; bred from cherry also.

1824.—Shotwell, W. American Farmer, VI., 14. Records the successful use of a lime mortar wash.

Thomas E. American Farmer, VI., 37. Erroneous account of the life-history; thought there were two broods. Briefly described the female only as an Hymenopteron, Apis persica. Borers numerous on nursery stock. Same account in New England Farmer, III, p. 12.

Smith, J. American Farmer, VI. 324-5. Very good summary of methods then recommended. Moths bred and submitted to Mitchell and Say. Quotes Worth (1823) entire.

1825.—Say, T. American Entomology, II., pl. 19. Revision of original description of moths. Worth, Shotwell and Thomas freely quoted regarding habits and methods of preventing. Fairly good colored figures of the male and female moth, the cocoon and the pupa skin; these are the first pictures of the insect ever published.

In the Le Conte edition of Say's writings, published in 1859, and in the Foote edition of 1891, this article is reprinted on pages 36-42, pl. 19, vol. I.

Haines, R. American Farmer, VI., 401. Records success with sand in mounds and in boxes or cases around trees.

1826.—Harris, T. W. New England Farmer. V., 33. Perhaps the best of the earlier accounts. Many references and quotations from earlier writers. Insect described as *persicae*; and the statement made that this name of Barton has priority over Say's *exitiosa*. Recommendations of Worth, Shotwell and Thomas summarized. Finds there is but one brood of the insect in a year. Thought he found the larvae in black-knot on plum trees.

1827. Stabler, T. P. American Farmer, IX., 29. Experiments showing that a mortar of cow-dung and clay was not always effectual.

1832. Brown, T. Book of Butt. Moths and Sphinges, p. 17, fig. 63. Quotes Worth (1823).

1835. "Senex" (Kinderhook, N. Y.) The Cultivator, II, 40. First saw it near Philadelphia, in 1800, from whence it spread northward at the rate of 12 to 15 miles a year, reaching Kinderhook in 1807. Thought eggs were laid on leaves on which larvae fed for a time. Mistook female for a parasitic wasp. Apparently the first account of the insect in New York literature.

1839.—Lancaster, S. The Cultivator, VI., 133. Notes on development of insect in Tennessee; no cocoons June 1st and a few found July 18th. Hens of no use. Mounding good and facilitates digging out.

Harris, T. W. Sillman's Jour. of Sci. and Art, XXXVI., 312. Adults described, with brief note referring to previous writings.

1841. The Cultivator, VIII., 90. Recommends planting a red cedar tree with the peach; the odor of the cedar thought to keep the insect

away. P. 95 records that Dr. Anderson, of Virginia, has practiced this method with success.

Harris, T. W. Rept. on Insects of Mass. Inj. to Veg., 232-234. Good general article, practically a recast of his 1826 article. In the 1842 edition, the 1852 edition (p. 253), and the Flint edition (p. 331) of Harris' Report there is no change from the 1841 article, except that figures of the larva, pupa and adults are added in the 1862, or Flint edition.

1844. Gaylord, W. Trans. N. Y. State Agr. Soc. for 1843, p. 161-62. Brief general account compiled from Harris (1841). Rather crude figures of adults, cocoon and pupa skin, evidently adapted from Say's. Suggests salt around tree.

1845.—Downing, C. Fruit and Fruit Trees, 460-461. Brief compiled account, not changed in subsequent editions. Recommendations, air-slacked lime or ashes.

1846.—The Cultivator, III., N. ser. 217. Good general compilation, with illustration of work of borer in tree, and of a cocoon.

L'Hommedieu. Trans. Cincinnati Hort. Soc. for 1843-45, p. 17. Used salt and saltpetre without success, but slacked lime gave good results.

1854.—Emmons, E. Nat. Hist. of New York, Agriculture, V. 222. Brief account compiled from Harris. Pl. 26, figs. 1-5, male and female, larva, pupa and cocoon. Fair, colored figures.

1855. Fitch, A. First Rept. on Insects of New York, 108-117. One of the best accounts in the literature, by far the best up to that time. Detailed descriptions of all the stages, including several varieties of the adults. Larva and its work poorly figured.

Glover, T. Rept. Com. of Patents for 1854, p. 83-84, pl. 7. Good brief account. Fairly good figures of male and female, larva and pupa in cocoon.

1856.—Fitch, A. Third Report on Insects of New York, 356. Brief account, with fair figures of male and female.

1858. The Northern Farmer (Utica, N. Y.), V. 116. Record of successful use of tansy.

1859. Merriam, J. P., and Meehan, T. Gard. Monthly, I., 168. Record successful use of gas tar.

1860. Peticolas, T. V. Country Gentleman, XV., 226. Records negative or disastrous results with many of the methods then recommended. Good general discussion of methods.

Morris, Miss M. H. Horticulturist, XV., 118. Brief, popularly

written account with crude original figures of male and female, a pupa and a cocoon.

1862.—Harris, T. W. Insects Injurious to Vegetation (Flint edition), p. 331-332. Same as the 1841 account, with figures of the larva (Fig. 161), pupa (Fig. 162), male (pl. V., Fig. 6), and pupa skin (pl. V., Fig. 7); very good figure of the male.

1866.—Walsh, B. D. Practical Entomologist, I., 27-28. Brief, general account, with a good discussion of various methods for combatting it. Fair figures of male and female.

1869. Walsh, B. D., and Riley, C. V. American Entomologist, I., 180-181. Very full discussion of the "mounding system." The system is further discussed from experience by Wells and Dean on pp. 201 and 222.

Riley, C. V. First Rept. on Insects of Missouri, 47-50. Good general account; mounding system especially treated. Fair figures of male and female.

1870. Fulton, J. A. Peach culture, 120-125. Brief account of life-history, with rather poor figures of male and female. Good sensible discussion of methods of combatting.

1871.—Saunders, W. Canadian Entomologist III., 22. Detailed description of the larva, the first and about the only one published. Poor picture of larva.

Bateman, M. B. American Agriculturist, XXVIII., 141. Records successful experiments with coal tar, with a detailed account of use of Buchan's carbolic soap.

1872.—Fitz, J. The Southern Apple and Peach Culturist, 264-260. Fairly accurate account of life-history. Excellent discussion of mounding, scalding, various washes and other applications on soil around tree.

1873.—Reed, E. B. Rept. Ont. Ent. Soc., for 1872, III, 44-47. Very good general article compiled from Say, Harris, Fitch and Riley. Fair figures of male and female and Saunders' poor figure of larva.

1875.—Cook, A. J. Rept. Mich. Bd. of Agr., for 1874, p. 136. Brief, good account of life-history and methods for controlling the insect. Practically the same article in Rept. Mich. Pom. Soc. for 1874, p. 140-141.

1876.—Bateman, M. B. Country Gentleman, p. 535. Records fairly successful experiments with tarred paper, and good results with a carbolic acid soap.

1877.—Thomas C. First Rept. on Insects of Ill., 38-39. Brief general account compiled mostly from Fitch.

1878. French, G. H. Seventh Rept. of State Ent., of Ill., 169-170. Brief compiled account.

1879, Milton, M., Country Gentleman, XLIV., 119. Records the insect in azaleas.

1880.—Comstock, J. H. Rept. of U. S. Ent. for 1879, p. 254-255. Detailed description of the egg, oviposition, and habits of the newly-hatched larva. Straw bandage recommended. Four parasites recorded.
Rutter, J. Culture and Diseases of the Peach, p. 74-76. Brief account, with good discussion of methods in combatting.
Fuller, A.—American Entomologist, III., 11. Records insect working in dwarf flowering almond shrubs.

1881.—Zimmerman, C. D. Gard. Monthly, XXIII., 238. Discusses the borer in nursery stock. Mounding the best method in a nursery.
Kellicott, D. C. Canadian Entomologist, XIII., 7, Brief, but important, note on emergence and habits.

1882.—"Anti-borer." Country Gentleman, XLVII., 373. Decline in profitable peach culture due to borer and not to climate. Successful with clean culture and "digging-out" process.
Edwards, Hy. Papilio, II., 55. Describes Fitch's var. as *fitchii*, in wild cherry from Fla. W. Va.

1883.—Cooke, M. Injurious Insects, 126-127. Brief general account. Saunders' figures.

Lintner, J. A. Psyche, IV., 106; also in Second Report on Insects of New York, 213. Points out a distinguishing characteristic of the male pupa.
Saunders, W. Fruit Insects, 191-195. One of the best general accounts of the insect.

1885.—Lintner, J. A. Second Rept. on Insects of New York, 5-6. Brief discussion of methods of combatting; pp. 24-26, discussion of carbolic soap washes.

1886.—Wilcox, Peach Culture, 43-45. Brief account, with discussion of "mounding system."

1887.—Treat, Mary. Injurious Insects, 183-185. Brief account.

1888.—Hale, J. H. Trans. Mass. Hort. Soc. for 1888, Part I, p. 66. Hale's Wash recommended.
Barry, P. Fruit Garden, p. 488. Good, brief account.

Lintner, J. A. Country Gentleman, LIII., 109. Full discussion of time of emergence and egg-laying.

"H. F. H." Kentucky. Country Gentleman, LIII., 149. Time of flight in Kentucky from June 6 to October, mostly from July 15 to August 15. Mounding most practical remedy.

Crossman, S. H. Ark. Rep. 1888, pp. 9-11. Aegeria exitiosa.

Crossman, S. Ark. Expt. Sta., Bull. 3, pp. 3-5. Brief discussion of habits and "remedies."

Atkinson, G. F., S. C. Rept. 1888, p. 37, Aegeria exitiosa.

Ashmead, W. H. Fla. Exp. Sta., Bull. 2, pp. 17-19. Brief discussion with descriptions of all stages. Recommends a Paris green soap wash.

1889.—Lintner, J. H. Country Gentleman, LIV., 861. Good account of name, appearance (poor figures of male and female), life history and remedies.

Smith, J. B. N. J. Rep. 1889, pp. 299-302. Sannina exitiosa.

1890.—Insect Life, II., p. 378, and III., p. 79. Successful experiments with hot water recorded.

Packard, A. J. Forest Insects, p. 521-522. Records it on wild cherry trees.

Washburn, F. L. Oregon Bul. No. 5, 1890, p. 8. Fig. 1. Aegeria (Sannina) exitiosa.

Hopkins, A. D. W. Va. Rep. 1890, p. 157, Aegeria exitiosa.

Kellicott, D. S. Jour. Columbus Hort. Soc., V., 16, pl. I, Figs. 1 and 2. Brief note, with very good figures of male and female. This article is wrongly accredited to Coquillett by Lintner and others.

Smith, J. B. Rept. N. J. Expt. Sta., for 1889, pp. 299-303. Brief account of habits, with good discussion of "remedies." Recommends hot water or kerosene emulsion to kill, and newspaper wrapping to prevent.

1891.—Weed, C. M. Insects and Insecticides, pp. 77-79. Good, brief account. Kellicott's figures.

McCarthy, G. N. C. Expt. Sta., Bull. 78, p. 27. Brief account. Dangerous to use Paris green washes.

Weed, H. A. Miss. Expt. Sta. Bull. 14, pp. 17-18. Brief, compiled account, with Kellicott's figures.

Townsend, C. H. T. New Mex. Expt. Sta., Bull. 3, pp. 13-15. Brief account. Attacks apricots. Irrigation, allowing water to stand for some time, has no effect.

Coquillet, D. and Riley, C. V. Insect Life, III., 392-93. Records *exitiosa* on Eastern nursery stock in Calif. Compared with the native California peach borer.

Snyder, R. Country Gentleman, LVI., 677. Very sensible article on washes and similar applications. Good "digging out" method described.

Woodward, J. S. Rural New Yorker, p. 736. Formula for soap, milk, and cement wash. Ashes are dangerous.

Lintner, J. A. Country Gentleman, LVI., 457. One of the best discussions of methods of controlling this insect in the literature. Same account occurs in his Eighth Rept. on Insects, of N. Y., p. 181-186 (1893). Uses Kellicott's (1890) fine figures, and reproduces "Emmons" poor figures.

Little, S. A. Rural New Yorker, L., 593. Good, popular, compiled account.

1892.—Barnes, W. D., Hale, J. H., Brown, N., and White, J. F. Rural New Yorker, LI., 186-187. Symposium on remedies. Hale's Wash and others found ineffectual.

Kellogg, V. Common Injurious Insects of Kansas, pp. 91-92. Good, brief account. Records it as appearing as early as April in Kansas, and having been in the state as early as 1873.

1893.—McCarthy, G. N. Car. Expt. Sta., Bull. 92, pp. 104-105. Brief account of habits, with good discussion of methods for combatting.

Atwood, W. B. Va. Bul. No. 24, Jan., 1893, pp. 9. Sannina exitiosa.

1894.—Neumoegen, B. Ent. News, V., 331 var. *luminosa* described.

Morgan, H. A. La. Bul. No. 28, 2nd ser. 1894, pp. 100-104.

Bailey, L. H. N. Y. Cornell, Bul. No. 74, Oct., 1894, p. 376. Sannina exitiosa. Also Report of Station for 1894, p. 376.

Sempers, F. Injurious Insects, pp. 86-87. Brief account; Riley's figures.

Hale, J. H. Rural New Yorker, Mar. 10, 1894, p. 151. Describes his "wash" and its use.

Taft, L. R., Sannina exitiosa. Mich. Bul. No. 103, Feb., 1894. pp. 45-46.

1895.—Comstock, J. H. Manual for the Study of Insects, p. 260. Brief account.

Davis, G. C. and Howard, L. O. Bull. 2 (N. ser.), U. S. Division of Ent., pp. 33 and 34. Raupenleim recorded as ineffectual, and linseed oil applications dangerous.

Weed, C. M. Insects and Insecticides, Second Edition, p. 121-122. Nearly same as 1891 account, except white paint is recommended instead of Paris green and glue. Poor figure of adults.

McCarthy, G. N. Car. Expt. Station, Bull. 120, pp. 292-293. Brief account.

Davis, G. C. Mich. Expt. Sta., Bull. 121, pp. 31-32. .Brief account.

Stinson, J. F. Ark. Expt. Sta., Bull. 33, pp. 72-74. Brief, compiled account.

Smith, J. B. N. J. Expt. Sta., Bull. 111, p. 6. Records apparently successful experiments, with Raupenleim and Dendrolene.

1896.—Marlatt, C. L. Circular 17, N. ser., U. S. Div. of Ent., 4 pp. Best brief, general discussion in the literature and illustrated by fine original figures of male and female pupae and adults, larva and cocoon.

Smith, J. B. Ent. News, VII., 107-109. Good general account of life-history and remedies.

"G. E. M." Rural New Yorker, Aug. 22nd, 1896, p. 560. Data on life-history in Virginia; finds difference in infestation of plums when budded on different stocks.

Smith, J. B. Economic Entomology, pp. 261-262. Good, brief account, with Kellicott's figures.

Cole, R. D., Massey, W. F., Wright, C., and Kerr, J. W. Rural New Yorker, Aug. 8, 1896, p. 533. Symposium on probable effect of kainit on borer.

Slingerland, M. V. Rural New Yorker, Dec. 5th, 1896, p. 800. Brief account, based on original observations and experiments.

Slingerland, M. V. Michigan Fruit Grower, Dec. 11, 1896, Vol. V., p. 8. (Same in Rept. Mich. Hort. Soc. for 1896, pp. 342-343. Brief account of some of the results reached in many experiments against the insect.

Price, R. H. Texas Bul. No. 39, July, 1896, p. 847, Fig. 1.

Beutenmuller, W. Bull. Am. Mus. Nat. Hist., VIII., 126. New genus Sanninoidea proposed for exitiosa, but not characterized. S. exitiosa and its varieties *fitchii* and *luminosa* described, the former incorrectly so.

1897.—Smith, J. B. Ent. News, VIII., 208. Important notes on life-history; p. 233-234. Detailed discussion of emergence and egg-laying habits. Pl. XI., good, enlarged, photo-reproduction of male and female.

Earle, F. S. Alabama College Stat. Bul. No. 85, Aug., 1897, pp. 438-439. Sannina exitiosa.

Lowe, V. H. N. Y. Expt. Sta. Bul. 136, Dec., 1897, pp. 595-596.

Bogue, E. E. Sannina exitiosa. Okla. Bul. No. 26, June, 1897. pp. 18-19; Fig. 2.

Lowe, V. H. Fifteenth Rept. N. Y. Expt. Station, pp. 5. Very good general account, with good photo-reproductions, its work, and poor illustrations of adults, larvae and cocoon.

Slingerland, M. V. Rural New Yorker, Dec. 11, 1897, p. 805. Brief account.

"E. T." Rural New Yorker, Jan. 2, 1897, p. 6. Records finding borers in the gum in winter.

Beutenmuller, W. Bull. Amer. Mus. Nat. Hist., IX, 219. Food plants.

Butz, G. Penn Expt. Sta. Bull. 37, p. 23-25. Brief account. E. F. Smith's figures and photo-reproduction of effect of borer on trees.

Lowe, V. H. Proc. Western N. Y. Hort. Soc. for 1897, p. 65-66. Brief account of life-history and habits; experiments with Dendrolene

Cordley, A. B. Oregon Expt. Station Bull., 45, pp. 100-107. Good discussion, with poor photographic figures, of the Oregon peach and

prune borer, supposed to be S. exitiosa. Specimens submitted to Washington authorities, however, show that Oregon species is *opalescens,* thus there is yet no definite evidence that *exitiosa* occurs in Oregon.

1898.—Country Gentleman, LXIII., p. 328. Good popular discussion compiled from recent bulletins.

Smith, J. B. Ent. News, IX., 79-114-115. Detailed account of some peculiar structural characteristics of the adults, illustrated by a full-page plate.

Starnes, H. N Ga. Expt. Sta., Bull. 42, p. 226. Good brief account with E. F. Smith's figures.

Stedman, J. H. Missouri Expt. Sta., Bull. 44, pp. 12-14. Brief account of life-history, with Kellicott's figures. Good discussion of remedial measures based on experiments. Recommends a wash of soap, soda, lime, carbolic acid and Paris green or arsenic; also recommends wire gauze or thin wooden wrappers as mechanical preventives.

Slingerland, M. V. Rural New Yorker, Jan. 15, 1898, p. 34. Detailed discussion of use of carbon bisulphide against the insect, with record of some experiments.

Slingerland, M. V. Proc. Western N. Y. Hort. Soc. for 1898, p 67. List of applications found non-effective, partially effective, and injurious when used against the peach-tree borer in experiments.

Faville, E. and Parrott, P. Kans. Expt. Sta. Bull. 77, pp. 44-47. Good account of the work of the borer, with good new illustrations.

Craig, J. Ottawa Expt. Farm. Bull. 1, Sec. Ser. p. 44. Brief note regarding some of the results of experiments against the insect at Cornell Exp. Sta.

Baker, C. F. Ala. Expt. Sta., Bull. 90, pp. 27-32. Very good general discussion of life-history and remedies. Experiments with Bordeaux mixture and Dendrolene. Illustrated with the good figures of Kellicott and Marlatt.

Smith, J. B. N. J. Expt. Sta. Bull. 128, 28 pages. Being based on original observations and experiments. This is one of the best and most detailed accounts of the life-history and methods of combatting the peach-tree borer in the literature. Records experiments with various mechanical protectors, and with cement and other washes. Illustrated by many new pictures of the different stages of the insect, its structural characteristics, and its work.

1899.—Lugger, O. Fourth Rept., Minn., p. 57-59. Brief general account, quoted mostly from Saunders (1883). Uses Kellicott's (1890) fine figures.

Fernald, H. T. Penn. Dept. of Agri., Bull. 47, pp. 14-15. Brief account with Lowe's figures.

Slingerland, M. V. Rural New Yorker, Mar. 25, 1899, p. 222. Results of experiments with tarred paper.

Slingerland, M. V. Trans. Mass. Hort. Soc., Part 1., for 1898, 5 pages. Brief account of life-history with somewhat detailed state-

ment of results obtained with the various methods used in extensive experiments against the insect.

Beutenmuller, W. Bull. Am. Mus. Nat. His., XII, 159. Genus Sanninoidea defined. Variations of exitiosa discussed; variety *fitchii* shown to have been incorrectly described; and the varietal name *edwardsii* proposed for the females, var. *luminosa* described.

Slingerland, M. V. N. Y. Cornell Bull. 176, Dec. 18, 1899, pp. 155-233, Figs. 16, abridged ed. pp. 16, Figs. 12. Sannina exitiosa. Excellent account from original investigations. The most complete work published.

1900.—Arnold, C. G. Notes on the Peach and the Borer. American Gardening, edition of Feb. 17.

Close, C. P. "Plant Diseases and Insect Pests." Bulletin 65, Utah Agr. Expt. Sta., Feb., 1900.

Johnson, Willis G. "Fall Treatment of Peach Trees Infested with Peach-tree Borer." Circ. 27, Maryland State Hort. Dept., Nov., 1900. Short account with suggested remedies.

Johnson, Willis G. "The Peach Borer." Article in Country Gentleman, Nov., 1900.

Brunner (L) and Hunter (W. D.), "Insect Enemies of Stone Fruits." Report Nebraska Hort. Society. Brief notes.

Forbes, S. A. Report Illinois State Entomologist. Brief notes.

1901.—Beutenmuller, Wm. Monograph on the Sessiidae. Mems American Museum of Nat. History, Vol. I, part VI, p. 265-271.

Green, E. C. "Insect Enemies of Tree and Fruit, and How to Control Them." Transactions Ills. Hort. Soc'y., May, 1901.

Slingerland, M. V. "Further Experiments Against the Peach-tree Borer." Bul. 192, Cornell Univ. Expt. Station. Stedman's wire cages and wooden casings again tested and adversely reported on; gas-tar treatment recommended; new fungus disease of borer noted.

Johnson, Willis G. "Sure Remedy for Peach-tree Borers" (gas tar). American Agriculturist, July 6th, 1901.

Forbes, S. A. "Principal Nursery Pests Likely to be Distributed." Circ. No. 36, Ills. Agr. Expt. Station, July, 1901.

Smith, W. B. "Insect Enemies to Fruit and Their Remedies." Proceedings Columbus Hort. Soc'y, for 1901.

Sherman, Franklin, Jr. "Injurious Insects." Bul. No. 22, N. C. State Board of Agr. Brief Notes.

Gillette, C. P. "Insect Enemies of Pear, Plum, Peach and Cherry." Report Colo. State Board of Hort. Brief notes.

1902.—Scott (W. M.) and Fiske (W. F.), "Jarring for the Curculio, with a List of the Insects Caught." Bul. 31, N. S. Div. Ent. U. S. Dept. Agr., Jan., 1902.

Smith, J. B. "The Entomologist's Experiment Orchard." Bul. 155, N. J. Agr. Expt. Station.

Slingerland, M. V. "Dipping Peach Roots for Borers." Rural New Yorker, March 29th, 1902.

Wadhams, S. W. "Killing Peach-tree Borers with Coal Tar." American Agriculturist, March, 1902.

Gillette, C. P. "Insects and Insecticides." Bul. 71, Colo. Agr. Expt Station, April, 1902.

Davis, K. C. Bul. 82, W. Va. Expt. Sta., pp. 402-403. Brief notes.

Scott, W. M. "The Peach-tree Borer." Proc. N. Ga. Fruit Growers' Assn., May 30, 1902. Brief discussion with recommendation of "Scott's Formula."

Banks, N. "Principal Insects Liable to be Distributed on Nursery Stock." Bul. 34, U. S. Div. Ent., U. S. Dept. Agr., June, 1902.

Fiske, W. F. Proc. 26th An. Meeting Georgia State Hort. Soc'y. Commends gas tar, which, under test, proved satisfactory and harmless to trees.

Hine, J. S. "Orchard Insects." Proceedings Columbus (O.) Hort. Soc'y. Brief notes.

Fernald, H. T. "Some Common Insect Pests of the Farmer." Bul. 99, Penn. Dept. Agr. Brief notes.

Herrick, G. W. Report Botanist and Entomologist, Miss. Agr. Expt. Station. Brief notes.

1903.—Sherman, Franklin, Jr. "Injurious Insects." Bul. 24, N. C. State Board of Agr., June, 1903.

Sherman, Franklin, Jr. "Insect and Fungus Enemies of Peach, Plum, Cherry, Fig and Persimmon." Bul. 186, N. C. Agr. Expt. Station, July, 1903. Brief notes.

Starnes, H. N. "Two Orchard Maladies—Brown Rot and Peach Borer." Press Bul. 43, Ga. Expt. Station, Sept., 1903. Gives the accepted life history for Georgia.

Marlatt, C. L. "The Peach-tree Borer." Circ. 54, Div. Ent., U. S. Dept. Agr., Nov., 1903. (Revising Circ. 17).

Horsfall, T. "Orchard Enemies." Bul. 9, Missouri Fruit Station, Dec., 1903. Brief notes.

Newell, Wilmon. "Insects of Georgia." Proc. 16th An. Meeting Assn. Ec. Ent. Bul. 46, Div. Ent., U. S. Dept. Agr. Brief notes.

Forbes, S. A. "Noxious and Beneficial Insects of the State of Illinois." 22nd Report State Entomologist.

Sargent, H. D. "The Peach-tree Borer." Proc. 1st An. Meeting. Ala. Hort. Soc'y., Jan. 26th and 27th, 1903. Compiled information.

Holland, W. J. "The Moth Book," p. 384; also colored plate XLVI., Figs. 18 and 19.

Porter, C. M. "The Peach-tree Borer." A 4 p. circular. Gives for the first time, correct life-history for Georgia. Marlatt's figures.

Herrick, G. W. Report Miss. Agr. Expt. Station for 1902-3. Brief notes.

1904.—Hale, J. H. "Peach Borers." Green's Fruit Grower.
Cooley, R. A. 1st An. Report State Entomologist of Montana Bul. 51, Mont. Agr. Exp. Station, Jan., 1904.
Sherman, Franklin, Jr. "The Peach-tree Borer." Ent. Circ. No. 7 N. C. Dept. Agr., Feb., 1904. Correct life-history for the South.
Newman, C. C. "Results of Practical Experiments with the Peach Borer." Bul. 83, S. C. Agr. Expt. Station.
Sherman, Franklin, Jr. "The Peach-tree Borer." Paper in Progressive Farmer, of Raleigh, N. C. Correct life history for the South
Symons, T. B. "Some Insects That Attack Fruit Trees in the Spring." Circ. Bul. 57, Md. Agrl. Expt. Station. Brief Notes.
Berckman's, L. A. Proc. 28th An. Meeting, Ga. State Hort. Soc'y, p. 90. Advocates "Scott's Formula."
Surface, H. A. "The Hot Lye Application for the Peach-tree Borer." Vol. II, No. 6, Monthly Bul. Div. Zool., State Dept. Agr. of Pennsylvania.
Herrick, G. W. Report of Ent. Miss. Agr. Expt. Station for 1904.
Pettit, R. H. "Insects Injurious to Fruits in Michigan." Special Bul. 24, Michigan Agr. Expt. Station.
Cooley, R. A. 2nd An. Report State Ent. of Montana. Bul. 55, Mont. Agr. Expt. Station. Brief mention with Marlatt's figures.
Starnes, H. N. Under "Plum Maladies," in Bul. 67, Ga. Expt. Station, Dec., 1904. Correct brief statement of life-history in Georgia with suggested remedies.

1905.—Johnson, J. M. "The Peach-tree Borer." Univ. Ga. leaflet, Vol. 1, No. 9. Reproduces standard account of life-history and remedies.
Symons, T. B. "Common Injurious and Beneficial Insects of Maryland." Bul. 101, Md. Expt. Station, p. 145. Brief notes, with remedies; Marlatt's figures.
Surface, H. A. Vol. III, No. 3, Monthly Bulletin, Div. Zool., Penn. State Dept. Agr. Contains remedial directions.
Starnes, H. N. Under Maladies of Japan and Hybrid Plums. Bul. 68, Ga. Expt. Station, Aug., 1905. Gives correct life-history for Georgia with brief suggestion of remedies.
Starnes, H. N. "The Peach Borer." Proc. 29th An. Meeting, Ga. State Hort. Soc'y., Sept. 5th and 6th, 1905, pp. 61-65. Correct life-history for Georgia, with remedies.
Smith, R. I. "Peach Insects." Bul. 17, Ga. State Bd. Ent., Oct., 1905. Correct life-history and remedial measures.
Starnes, H. N. "The Peach-tree Borer." Bul. 173, Ga. Expt. Station, June, 1906. Correction of the seasonal history for Georgia—an excellent bulletin.

Quaintance, A. L., Year Book. Dept. Agr., 1905, p. 330-335. Excellent account. (Reprinted in a separate).

1909.—W. E. Britton. Conn. State Rep., 1909-10. Pt. 4, pp. 359-362. Pl. 1. Sanninoidea exitiosa.

Conradi, A. F., and Thomas, W. A. S. C. Rep., 1909, pp. 124-127, Charts 3. Sanninoidea exitiosa.

Berckman's, L. A. "Commercial Peach Orchards," "American Fruits." July, 1909. Recommends lime, tar and sulfur mixture.

Smith, J. B., Rept. Ent. Dept., N. J. Agr. College Expt. Station, 1909, p. 399-402. Results of some experiments.

1911.—J. P. Green. "How to Combat with the Peach-tree Borer," "Better Fruit," May, 1911. Vol. V., No. 11, p. 43.

Smith, J. B. Bul. 235, N. J. Agr. Expt. Station, 1911, p. 5-13. Recommends lime sulfur and arsenate of lead.

1912.—H. E. Angell. "Fighting the Peach-tree Borer." Country Life, Sept. 1, 1912.

D. E. Howell, Country Gentleman, May 11, 1912, p. 19. Recommends use of kerosene in channels; hot coal tar oil on trunks and tar paper on small trees. Confuses curculio and borer.

E. L. Morris. "The Pear Thrips and Peach-tree Borer," Bul. Univ. of California, No. 228. Recommends hard asphaltum of grades C. and D., but falls back on "worming."

THE MARYLAND AGRICULTURAL EXPERIMENT STATION.

BULLETIN 177. MAY 1, 1913.

OPEN STABLES VERSUS CLOSED STABLES FOR DAIRY ANIMALS.

By S. S. Buckley.

Any departure from well-established practice is slow in breaking down the barriers of custom, even though possessing considerable merit. Cow stables and their ventilation have been live subjects of study for years, and wonderful results have been accomplished by these studies. The comparison of the results of stabling cows must be made from many points of view. Some of the influences of stabling are difficult of measurement, viz., health and stamina.

The comparison of the results of stabled cows and of those which have not been stabled has heretofore been misleading, from the fact that the feeding, care and management of cows usually bear direct relation to the character of stabling accommodations. As a rule cows which are kept in inferior shelters have scant and inferior foods provided, while high-class stables indicate more suitable and more abundant rations. The efficiency of stables is usually measured by sanitary standards, economy of labor and the amount and cost of the products of the cows. The ultimate effect upon the health and stamina of cows, housed under different conditions for a number of generations, has never been determined. In a general way deductions have been drawn from the association of extensive disease infection with dark, damp and ill-ventilated buildings, and from better health in high-class stables. Numberless exceptions, however, are to be found to each of these.

Aside from the effect upon the progeny of the stabled cows, its sanitary character and conveniences, a stable must be suited to the nature of the work that is to be performed in it. In general the stable of the breeder would not appeal to the producer of market milk, nor would the dairyman with fifteen cows select the same type of buildings as would one who has a hundred or more cows to care for. Each establishment, therefore, has special problems to be worked out to suit its conditions.

Large Buildings or Small Units.

Some dairymen prefer stables which will accommodate 100 to 200 animals, while others would house the same number in stable units of not more than 25 to 50 cows each. The aggregate of small units has greater initial cost and the expense of labor may even be greater than in the larger stables, yet, on the other hand, the dangers of spread of infection, fire, or other reasons may make the unit system of construction much more desirable.

The farm barn is frequently made to furnish accommodations for all classes of farm animals. It is allowable to stable dairy animals in the same building with horses and sheep, but tight partitions are required in order to meet the requirements of the Health Department regulations. It is a common practice to have cows in milk, dry cows, heifers, calves and the bull in the same room, but confined in stalls and pens. The evil consequences of both of these practices will be pointed out in the discussion of our conception of a model equipment of stables and yards for the dairy farm.

One-Story Stable or Stables with Lofts.

In recent years it has been customary to design dairy stables without storage rooms above, and there are many who regard the production of clean milk to be impossible where roughage and feed is stored over the cattle. Contamination of the milk will depend, of course, upon the construction of the floors and ceilings and upon the location and character of the chutes which carry the feed from the loft and the arrangements for distributing it to the cows in the stable. Undoubtedly at the time of filling the loft, or cutting or shredding the roughage, there will be greater opportunities for dust to be blown through the stables than if the storage place were further removed. However, the disadvantages of distance, increased labor and the extra expense of an additional roof probably offset those attending the periodic filling or cutting and shredding operations.

Better opportunities for lighting are afforded by the one-story structure, while on the other hand better ventilation may be secured by the increased height of the two-story building.

Ventilation Systems.

Almost all conceivable methods have been advocated for the proper ventilation of cow stables. The most widely known system and probably the most commonly used in this country today, where anything like a system is attempted, is that recommended by King. The principle upon which the King system and most other systems are supposed to operate is based upon the difference in weight between a column of cold air and an equal column of warm air. Under favorable conditions of outside temperature and humidity, this system does excellent service. When temperature and humidity conditions are unfavorable, this system

fails. So it is with all systems not augmented by artificial heat or mechanical means for regulating the direction and force of air currents.

Ventilating systems for cow stables aim to remove foul air, bring in pure air and maintain more or less uniform temperatures, without creating chilling draughts on the animals, and to provide from 500 to 1,000 cubic feet of air space per cow.

The utilization of the radiated heat from the bodies of cows to prevent low temperatures in winter weather will always result in a degree of impurity of the air of stables. The probable dangers of stabling cows in a partially contaminated atmosphere have already been discussed in Bulletin 145 of this Station, and with reference particularly to tuberculosis this bulletin states:

"The degree of expansion to which the chest is subjected, directly influences the fullness of the terminal air cells, and consequently the movements of the lungs.

"The presence of carbon dioxide, due to its imperfect removal in the expiratory act, results in a diminished blood supply, and a more complete removal of carbon dioxide establishes a fuller circulation in the lungs. We find, therefore, that an animal in the protected stable makes a more shallow respiration, accompanied by only slight lung movements, and has a slight blood supply at the air cells.

"Such a condition of diminished oxygen supply, approximate rest of the tissues and a slight blood supply at the terminal air cells is favorable for the lodgement and propagation of the tubercle bacillus. Such a condition exists in cattle as at present housed, and such conditions demand correction."

Infections other than tuberculosis may be propagated and the general stamina of animals may be influenced by a continuous existence in an atmosphere which is no more impure than that commonly found in dairy stables.

Light in Stables.

The amount of light which it is possible to admit into stables is much more easily regulated than are most of the other sanitary requirements. Many stables are provided with almost continuous sashes, while other stables range in amount of light from an abundance to very limited amounts. Sanitary regulations recommend four square feet of glass, with even distribution of the light, for each cow. This recommendation is based upon the germicidal action of light and its favorable stimulation upon the animal organism.

Windows serve the double purpose of admitting light and of augmenting the ventilating system. Continuous sashes around a stable may prove to be uncomfortable for the cows on account of the glare from strong light, and it is necessary, therefore, to use judgment in locating the position of windows with reference to the position of the cows.

A large number of windows in a stable may be objectionable on account of the labor involved in keeping them clean. Muslin curtains stretched across the openings have probably minimized some of the

objectionable features of glass sash, inasmuch as the light is subdued, and considerable ventilation occurs through the muslin. The substitution of muslin for glass, however, has not become popular.

Comfort.

Any devices or arrangements for the comfort of the cows which do not oppose sanitary practices in stables are desirable. Among the things which bear upon the comfort of cows in stables are the ties, bedding, size of stalls and the temperature. The comparison of the comforts of cows under specific conditions of equipment and management will be made in the discussion of the experiences with the Open and Closed Stables.

Temperature.

The effects of temperature upon the function of milk secretion in dairy cows are apparently not as well understood as they should be. It is generally supposed that severe temperatures reduce the amount of secretion very perceptibly and dairymen are continually cautioned to avoid cold stables if they expect to produce milk economically. The experiences gained in the Open and Closed Stable comparison indicate that the evil effects of low temperatures have been greatly overestimated.

Self-registering (Draper's) thermometers were kept in the stables from November until April, and the daily registration tabulated.

The following tables give the maximum and the minimum temperatures for each week, and the mean daily temperatures for each month for the winter months of 1910-1911, 1911-1912 and 1912-1913.

Winter of 1910-1911.

Week.	Open Stable. Max.	Min. (Degrees.)	Mean.	Closed Stable. Max.	Min. (Degrees.)	Mean.
January 5	58	20	..	63	35	..
January 12	47	25	..	65	34	..
January 19	54	23	..	61	32	..
January 26	53	11	..	60	31	..
January Mean Daily	..	..	36	..	..	46
February 2	64	28	..	65	38	..
February 9	52	22	..	56	36	..
February 16	55	26	..	59	36	..
February 23	53	20	..	56	35	..
February Mean Daily	..	..	37	..	..	45
March 2	64	33	..	64	40	..
March 9	56	21	..	58	36	..
March 16	64	16	..	64	28	..
March 23	69	20	..	70	37	..
March 30	73	23	..	68	41	..
March Mean Daily	..	..	42	..	..	49

WINTER OF 1911-1912.

Week.	Open Stable. Max.	Min.	Mean.	Closed Stable. Max.	Min.	Mean.
	(Degrees.)			(Degrees.)		
November 13.........	66	30	..	65	37	..
November 20.........	71	26	..	68	33	..
November 27.........	54	29	..	63	40	..
December 4.........	57	27	..	57	35	..
November Mean Daily.	..	..	43	..	..	48
December 11.........	58	27	..	59	36	..
December 18.........	65	37	..	66	39	..
December 25.........	50	26	..	55	39	..
January 1.........	58	26	..	59	35	..
December Daily Mean..	..	..	42	..	..	47
January 8.........	51	7	..	53	21	..
January 15.........	33	6	..	39	23	..
January 22.........	47	—14	..	48	11	..
January 29.........	57	19	..	56	32	..
January Daily Mean...	..	..	27	..	..	39
February 5.........	39	4	..	46	26	..
February 12.........	37	12	..	43	29	..
February 19.........	43	8	..	48	31	..
February 26.........	55	27	..	55	36	..
February Daily Mean..	..	..	30	..	..	39
March 4.........	54	22	..	56	35	..
March 11.........	53	22	..	53	35	..
March 18.........	61	26	..	60	35	..
March 25.........	69	32	..	67	39	..
April 1.........	71	29	..	70	42	..
March Daily Mean.....	..	..	38	..	..	46

WINTER OF 1912-1913.

Week.	Open Stable. Max.	Min. (Degrees.)	Mean.	Closed Stable. Max.	Min. (Degrees.)	Mean.
November 8	67	26	..	70	35	..
November 15	71	40	..	71	45	..
November 22	68	29	..	67	36	..
November 29	59	24	..	63	39	..
November Mean Daily	..	..	45	..	..	52
December 7	60	28	..	64	36	..
December 14	51	20	..	57	36	..
December 21	55	31	..	58	35	..
December 28	47	20	..	53	33	..
December Mean Daily	..	..	40	..	..	46
January 4	..	..	..	..	..	..
January 11	66	27	..	67	35	..
January 18	65	29	..	66	34	..
January 25	61	30	..	63	36	..
February 1	63	31	..	63	38	..
January Mean Daily	..	..	46	..	..	49
February 8	41	21	..	48	32	..
February 15	44	14	..	51	29	..
February 22	63	29	..	62	39	..
March 1	67	22	..	64	35	..
February Mean Daily	..	..	37	..	..	45
March 8	57	25	..	60	33	..
March 15	66	36	..	67	47	..
March 22	70	31	..	70	42	..
March 29	76	31	..	76	42	..
March Mean Daily	..	..	51	..	..	54

Low Temperatures and Milk Secretion.

Open Stable

Date 1912	Pounds of Milk Secreted Daily — Cow No.													Temparature Degrees	
	56	110	128	132	136	137	144	146	147	150	154	158	193	Max.	Min.
Jan. 26th	15.5	31.4	22.7	20.6	23.9	14.7	20.2	19.4	14.0	12.8	12.1	14.2	17.0	47	44
Jan. 27th	17.7	31.8	22.6	20.2	23.6	14.7	21.3	19.4	14.1	13.0	11.8	15.0	17.8	44	25
Jan. 28th	14.5	31.0	23.1	19.7	23.6	15.5	20.6	18.6	13.2	12.6	11.7	14.2	17.1	20	—14
Jan. 29th	14.8	31.3	23.0	19.4	23.4	15.0	20.3	18.6	12.8	12.1	11.4	15.6	17.2	44	26
Jan. 30th	15.1	31.1	24.1	19.9	23.0	15.4	20.2	19.3	13.5	12.3	11.2	14.9	16.6	51	34
Jan. 31st	14.5	31.2	24.1	20.4	23.0	15.9	20.8	19.7	13.1	12 6	12.0	14.5	16.5	57	31

Closed Stable

Date 1912	Pounds of Milk Secreted Daily — Cow No.											Temparature Degrees	
	69	129	131	139	141	148	149	151	155	156	163	Max.	Min.
Jan. 26th	13.9	10.6	33.3	17.1	37.5	9.6	14.1	9.5	24.0	21.6	5.4	48	41
Jan. 27th	14.5	11.0	32.5	17.2	37.2	10.0	14.4	9.7	22.8	21.9	5.3	39	15
Jan. 28th	14.2	11.1	31.5	17.5	36.5	9 9	14.0	9.9	23.4	21.6	5.0	28	11
Jan. 29th	14.0	11.3	32.2	17.0	36.3	10.2	14.5	9.9	24.2	22.0	4.4	45	34
Jan. 30th	15.5	10.9	32.0	17.6	37.5	9.5	14.5	9.9	24.8	21.7	4.1	50	37
Jan. 31st	14.5	10.7	31.7	17.6	37.0	10.0	14.6	10.3	23.2	21.8	5.0	56	48

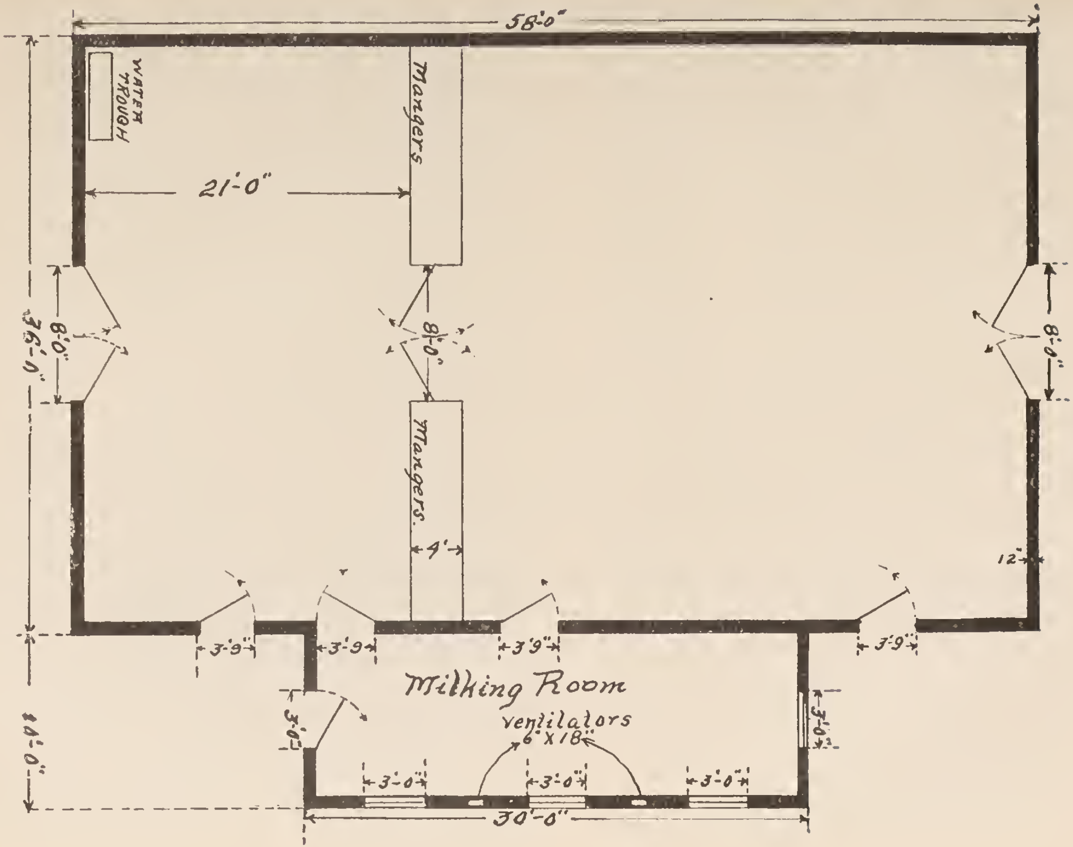
Comparison of the above tables will show that there is no greater variation in the flow of milk from the cows exposed to a temperature of —14 degrees in the Open Stable than in those cows in the Closed Stable which were exposed to a temperature of +11 degrees.

There is no instance in which there has been a decided decrease in production of milk, temporary or permanent, which can be attributed to low temperatures nor to sudden fluctuations in temperature, unless at the same time exposed to rain.

The atmospheric temperature outside the stables on the morning of the 28th of January, 1912, was —26 degrees F. and is within 1 degree of the coldest temperature on record at this place. It is therefore evident that this exposure is as severe as the cows are likely to be subjected to in this region.

Closed Stable Open Stable

M. A. E. S. Dairy Buildings



Floor Plan of Open Stable.

Description of Stables.

CLOSED STABLE.

The construction of this stable is of concrete, with concrete floors and slate roof. The building is 36 feet by 58 feet, outside measurement. The walls are solid and 12 inches thick, the ceilings are 8 feet 6 inches high in the clear. There are six windows on each side, three feet two inches by three feet eight inches; and two windows on each end of similar size. The sashes are hinged at the bottom, and arranged to open at the top to a distance of eight inches. The edges of the sashes are provied with triangular galvanized iron cheeks, which prevent any direct draughts upon the cows. In the middle of the ceiling there is an opening 18 inches by 36 inches, through which passes a telescoping ventilating flue. This may be lowered to within four inches of the floor or fixed at any point between this and the ceiling. The flue extends to the louvre ventilator in the roof.

This stable is arranged to accommodate 30 cows, in stalls three feet by four feet nine inches. The floors of the stalls are of concrete, damp-proofed with a heavy coating of tar three inches below the surface.

OPEN STABLE.

The construction of this stable is of the same materials as the Closed Stable. The dimensions are the same and the capacity the same. There are no stalls and the entire interior is free of obstructions, with the exception of a row of double mangers running across the stable, and dividing the space into two nearly equal compartments. The outside walls are only five feet high, and are continued by posts to support the roof. The space between the top of the wall and the plate is open between the posts, and is three feet six inches in height. The building, therefore, has a continuous open space entirely around it, three feet six inches high, with the exception of a part of one side, where the milking room adjoins it. The milking room is made to accommodate only three cows at one time. It has closed walls and two windows, corresponding to those in the Closed Stable. The general plan of construction is simple, being merely a floor space equal to that of the Closed Stable and covered by a roof. The sides of this space are protected as high as a cow's head when standing, with the outside walls.

The capacity of this stable is the same, of course, as the Closed Stable and is equivalent to a floor space of eight by eight feet or 64 square feet of floor space per cow.

There are two doors in the division wall of the milking room, one going to each of the compartments of the stable, and whose purpose will be explained in the operation of the Open Stable. There are also two wide doors in the walls of the stable to allow wagons or manure spreaders to pass through the building. An examination of the floor plan and view of the stable shows the simplicity of construction.

Purpose of the Open Stable.

The recommendation of the principle of open stabling for dry cows and heifers was originally made by the writer in 1897, when plans were being considered for the dairy herd of the Maryland Agricultural College. The design was not accepted, however, and until 1907, when the principles were incorporated in the present structure, which was designed for the Maryland Agricultural Experiment Station, and constructed during 1908, there was no opportunity to test out its merits.

The original object aimed at was the increase of the resisting powers of cattle to tuberculosis. It is believed that cows stabled in a structure of this kind, and the progeny of such cows will from generation to generation, gain in vitality to such an extent that they will ultimately be able to resist ordinary exposure to this infection. Circumstances have prevented experimental work along this line, and since its construction it has been used continuously as a stable for part of the dairy herd.

The Open Stable provides for all the advantages set forth by the Illinois Station in the discussion, "Should Dairy Cows be Confined in Stalls," together with the further advantages of abundance of fresh air, light and changing temperatures.

Feeding and Milking Operations in the Open Stable.

The cows occupy the open spaces of the stable during the time they are housed, and have access to the mangers for roughage, and to a plentiful supply of drinking water. The floor is abundantly supplied with bedding in the fall of the year, and as it becomes worked into the droppings, just enough new litter is supplied to keep the surface in good condition. After each removal of manure the floor is well supplied with fresh litter and the process of caring for it repeated.

At milking time the cows are all driven into one end of the stable and the bars or gate-way closed.

Three cows are then allowed into the milking room (space for more than three, in a stable of 30, is recommended) and fed grain. These are then milked and turned into the opposite end of the stable, directly from the milking room. A second set is then allowed in the milking room, fed, milked and turned out. This is continued until all are fed, milked and turned out.

The bars or gates are then opened and the cows given the freedom of the stable until the next milking time.

Results with the Open Stable.

The experiences gained by housing dairy cows in this type of stable have been highly satisfactory. The advantages and disadvantages will be enumerated in detail, but here may be mentioned the advantages of—

Economy of construction.
Fewer stanchions and mangers.
Economy of labor.
Better manure.
Cleaner cows.
Greater comfort of cows.
Slightly cheaper cost of feed in the production of milk.

Economy of Construction.

The first cost of construction of an Open Stable compared with the Closed Stable of the same size is less. This is due to the saving in the cost of doors, windows and frames, and the amount of wall or sides of the building. The extra cost involved in the additional milking room which is necessary is not sufficient to offset this saving and that of the floors.

Fewer Stanchions and Mangers.

The number of stalls which it is desirable to place in the milking room will depend upon the demands of the individual dairyman. It is recommended, however, that there be from five to eight for a stable with a capacity for 30 cows. In any event the saving on fixtures is considerable.

Economy of Labor.

The experience at this place indicates that a saving of from one and a half to two hours per day is made in the use of the Open Stable when compared with the same conditions of work in the Closed Stable. In addition to this daily saving of labor, there is the additional saving of the labor of cleaning the windows periodically, and the washing down of the floors. If the buildings were provided with storage space above the cows, the amount of time saved would be proportionately greater in the Open Stable.

Cleaner Cows.

Contrary to the general opinion held, cows become less soiled with manure and urine in the open space of the stable than when confined in stalls or tied in stanchions. It was necessary to clean the cows only once or twice each week to keep them in the same condition as those kept in the Closed Stable, which were cleaned once and frequently twice per day.

Better Manure.

The manure from the Closed Stable is wheeled to the manure heap, at some distance from the stable. The manure heap is exposed to the drying action of the sun and the wind or to the rains, as the

case may be. When it is possible the manure is taken directly to the fields and spread.

The manure in the Open Stable is allowed to remain on the floor and is covered with the loose litter, which is supplied in abundance in the first bedding of the stable. This practice is continued until all of the available loose litter is used, and then it is necessary to bring into the stable just sufficient for this purpose each day. The urine is completely absorbed and the solids are thoroughly incorporated with the bedding. The walking of the cows on this packs it into a firm mass and losses by evaporation are very slight. As a consequence the odors in this stable are very slight at any time and usually absent entirely.

The Open Stable requires cleaning out about once a month only. The time for this can be varied somewhat and it is always possible to get the manure directly to the land in prime condition.

The amount of litter required to keep the stables in proper condition has not as yet been determined, but there will probably be no great difference either way.

Cost of Feed to Produce Milk.

In another part of this report is given the results of a three years' test, which show a slightly cheaper production of milk in the Open Stable.

Comfort of the Cows.

There is difficulty in comparing the relative comfort of cows in the two types of stables. A general observation of the cows in the Open Stable under different conditions of temperature, during strong winds and during prolonged cold rains, seems to show no bad effects whatever. Apparent contentment as shown by normal appetite and flow of milk is the rule. Cows have given birth to calves in the Open Stable in cold winter weather and neither has appeared to suffer from the low temperature.

It must be borne in mind, however, that the cows will be comfortable only when they are not tied and are free to move about in the open space of the stable. Heifers were confind in a small space, partitioned off from the main portion of the stable, and had very little opportunity to walk about. At times of low temperatures and severe winds these gave evidence of some discomfort. As they were not in milk, the effect of this exposure could not be measured in any way.

A stable whose dimensions approach the square in form is probably better suited for this method of stabling than a long and narrow structure would be.

Criticisms Against the Open Stable.

There have been two disadvantages only, suggested against the use of the Open Stable, which it has not been possible to refute by the

results of actual experience. One of these is the low temperature of the milking room in extreme weather in winter. It is a fact that in the closed stable the body heat of the cows will raise the temperature of the stable and the milker will be more comfortable than in the milking room of the Open Stable. The objection to the use of the stable on this ground alone, however, is not a serious one, as it is a condition which can be overcome.

The second objection raised against the Open Stable is the arrangement for feeding roughage to the cows. It has been claimed that the greedy and strong cows will prevent some of the others from securing their share of the feed. The grain should be fed in the milking room, at milking time. Roughage should be provided in such abundance that there would never be a time when the cows could not secure it. In this way the objection would be entirely overcome, and, furthermore, when fed in this way more of the ration would be supplied by roughage and less grain would be needed. Only when roughage is supplied in amounts sufficient for a single ration for each cow will this objection be valid.

Sanitary Features of the Open Stable.

A determination of the bacterial content of the air and of the milk produced in the Open and Closed Stables has been made by Mr. R. Lamson, and is incorporated as a part of this report.

Efficiency of the Open Stable.

The degree of efficiency of a dairy stable is after all determined by its results in the quality and quantity of milk produced in it. The following test was conducted for the purpose of demonstrating these points. The test covered the months of three successive years when stabling was necessary, and when the amount of food consumed could be accurately determined. The cows used in the test were selected in such a way that the several lots were equal in weight, breed and period of lactation. No results have been recorded except from cows which remained in the test for an entire period or sufficiently long to not affect results adversely.

Feeding Experiment.

open versus closed stables.

In October, 1910, the dairy herd was divided into three sections. Two of these were kept in the closed stable and the third was kept in the open stable. During three months a number of dairy feeds were used alternately with these cows. Beginning January 1st, 1911, two lots were fed for a period of three months in the tests outlined below.

Table I shows the cows in the test; the kinds and amounts of food consumed and the type of stable in which they were confined.

TABLE I.

Lot I
OPEN STABLE.

Cows in the Test.

	Ration	132	136	137	144	145	146	151	154
January 1911	Sucrene	186	186	186	186	186	186	186	186
	Silage	930	930	930	930	930	930	930	930
	Alfalfa	93	93	93	93	93	93	93	93
	Stover	124	124	124	124	124	124	124	124
February 1911	Sucrene	168	168	168	171	168	186	186	186
	Silage	840	840	840	840	840	840	840	840
	Alfalfa	84	84	84	84	84	84	84	84
	Stover	112	112	112	112	112	112	112	112
March 1911	Sucrene	186	186	186	186	186	186	186	186
	Silage	930	930	930	930	930	930	930	930
	Alfalfa	93	93	93	93	93	93	93	93
	Stover	124	124	124	124	124	124	124	124

Lot II
CLOSED STABLE.

Cows in the Test

	Ration	110	131	133	141	148	149	158	163
January 1911	Sucrene	46	372	186	372	186	186	248	124
	Silage	930	930	930	930	930	930	930	930
	Alfalfa	93	93	93	93	93	93	93	93
	Stover	93	93	93	93	93	93	93	93
February 1911	Sucrene	90	282	140	274	168	168	168	60
	Silage	840	840	840	840	840	840	840	840
	Alfalfa	84	84	84	84	84	84	84	84
	Stover	84	84	84	84	84	84	84	84
March 1911	Sucrene	292	310	106	310	186	186	186	172
	Silage	930	930	930	930	930	930	930	930
	Alfalfa	93	93	93	93	93	93	93	93
	Stover	93	93	93	93	93	93	93	93

Table II shows the totals of the foods consumed by each lot for the month; the value per ton of the food; the total cost of food; the average cost per head; the total amount of milk; the value of the milk; the value of the milk per head; the cost of grain per 100 lbs. of milk and the total cost of food per 100 lbs. of milk in the Open and Closed Stables.

TABLE II.

Lot I
Open Stable

	Ration	Total Amount of Feed.	Value per Ton	Total cost of Feed.	Average cost of Feed per head.	Pounds of milk produced.	Value of milk.	Average value of milk per head.	Cost of Grain per 100 lb. milk.	Total cost of Feed per 100 lb. milk.
January 1911	Sucrene	1550	$25.	$19.375	$2.422	3499.4	$73.487	$9.186	$.553	$1.305
	Silage	7440	4.	14.880	1.860					
	Alfalfa	744	20.	7.440	.930					
	Stover	992	8.	3.968	.496					
				45.663	5.708					
February 1911	Sucrene	1347	25.	16.837	2.104	3088.4	64.856	8 197	.545	1.313
	Silage	6720	4.	13.440	1.680					
	Alfalfa	672	20.	6.720	.840					
	Stover	896	8.	3.584	.448					
				40.581	5.072					
March 1911	Sucrene	1488	25.	18.600	2.325	3387.2	71.13	8.891	.549	1.325
	Silage	7440	4.	14.880	1.860					
	Alfalfa	744	20.	7.440	.930					
	Stover	922	8.	3.968	.496					
				44.888	5.611					

Lot II
Closed Stable

	Ration	Total Amount of Feed.	Value per Ton	Total cost of Feed.	Average cost of Feed per head.	Pounds of milk produced.	Value of milk.	Average value of milk per head.	Cost of Grain per 100 lb. milk.	Total cost of Feed per 100 lb. milk.
January 1911	Sucrene	1720	25.	21.500	2.687	3470.6	72.88	9.11	.619	1.348
	Silage	7440	4.	14.880	1.860					
	Alfalfa	744	20.	7.440	.930					
	Stover	744	8.	2.976	.372					
				46.796	5.849					
February 1911	Sucrene	1350	25.	16.875	2.109	3138.8	65.915	8.239	.537	1.265
	Silage	6720	4.	13.440	1.680					
	Alfalfa	672	20.	6.720	.840					
	Stover	672	8.	2.688	.336					
				39.723	4.965					
March 1911	Sucrene	1748	25.	21.850	2.731	4458.8	93.635	11.704	.490	1.057
	Silage	7440	4.	14.880	1.860					
	Alfalfa	744	20.	7.440	.930					
	Stover	744	8.	2.976	.372					
				47.146	5.893					

Table III shows the cows in the test, the kinds and amounts of food consumed and the type of stable in which the cows were confined during the second year of the test.

TABLE III

LOT I
OPEN STABLE

Grain Mixture: Rye Distillers Grains 100 lbs
Gluten 100 lbs

Cows in Test

	Ration	56	128	132	137	144	146	193
October 1911	Grain Mix.	279	186	217	248	170.5	266	67.5
	Pasturage	For entire month						
November 1911	Grain Mix.	255	66	210	240	240	297	220
	Pasturage	For 14 days						
	Silage	595	595	595	595	595	595	595
	Cow Pea Hay	126	126	126	126	126	126	126
December 1911	Grain Mix.	263.5	204	217	217	248	263	186
	Silage	1085	1085	1085	1085	1085	1085	1085
	Cow Pea Hay	186	186	186	186	186	186	186
January 1912	Grain Mix.	186	236	217	186	248	248	168
	Silage	1085	1085	1085	1085	1085	1085	1085
	Cow Pea Hay	186	186	186	186	186	186	186
February 1912	Grain Mix.	174	232	203	174	190	213	174
	Silage	1015	1015	1015	1015	1015	1015	1015
	Stover	290	290	290	290	290	290	290
March 1512	Grain Mix.	124	248	186	186	186	155	186
	Silage	930	930	930	930	930	930	930
	Stover	310	310	310	310	310	310	310

LOT II
OPEN STABLE

Grain Mixture: Bran 100 lbs
Gluten 100 lbs

Cows in the test

	Ration	110	136	147	150	154	158	161
October 1911	Grain Mix.	155	93	248	232.5	186	265	——
	Pasturage	For entire month						
November 1911	Grain Mix.	135	163	195	225	180	240	——
	Pasturage	For 14 days						
	Silage	595	595	595	595	595	595	——
	Cow Pea Hay	126	126	126	126	126	126	——
December 1911	Grain Mix.	93	310	202	233	186	248	——
	Silage	1085	1085	1085	1085	1085	1085	——
	Cow Pea Hay	186	186	186	186	186	186	——
January 1912	Grain Mix.	108	276	201.5	201.5	186	248	——
	Silage	1085	1085	1085	1085	1085	1085	——
	Cow Pea Hay	186	186	186	186	186	186	——
February 1912	Grain Mix.	290	232	150	174	174	174	174
	Silage	1015	1015	1015	1015	1015	1015	1015
	Stover	290	290	290	290	290	290	290
March 1912	Grain Mix.	310	186	124	124	124	155	186
	Silage	1085	1085	1085	1085	1085	1085	1085
	Stover	310	310	310	310	310	310	310

TABLE III (Continued)

Lot III
Closed Stable

Grain Mixture: Rye Distillers Grains 100 lbs
Gluten 100 lbs

Cows in the test

	Ration	69	129	141	148	149	163
October 1911	Grain Mixture	248	248	93	93	217	139.5
	Pasturage			For entire month			
November 1911	Grain Mixture	240	225	112	120	156	135
	Pasturage			For 14 days			
	Silage	595	595	595	595	595	595
	Cow Pea Hay	126	126	126	126	126	126
December 1911	Grain Mixture	248	232.5	348	124	202	140
	Silage	1085	1085	1085	1085	1085	1085
	Cow Pea Hay	186	186	186	186	186	186
January 1912	Grain Mixture	248	232.5	310	124	201.5	139.5
	Silage	1085	1085	1085	1085	1085	1085
	Cow Pea Hay	186	186	186	186	186	186
February 1912	Grain Mixture	174	156	290	116	174	116
	Silage	1015	1015	1015	1015	1015	1015
	Stover	290	290	290	290	290	290
March 1912	Grain Mixture	155	130	310	124	125	93
	Silage	1085	1085	1085	1085	1085	1085
	Stover	310	310	310	310	310	310

Lot IV
Closed Stable

Grain Mixture: Bran 100 lbs
Gluten 100 lbs

Cows in the test

	Ration	155	156
October 1911	Grain Mixture	217	35
	Pasturage	For entire month	
November 1911	Grain Mixture	166	180
	Pasturage	For 14 days	
	Silage	595	595
	Cow Pea Hay	126	126
December 1911	Grain Mixture	45	228
	Silage	1085	1085
	Cow Pea Hay	186	186
January 1912	Grain Mixture	124	248
	Silage	1085	1085
	Cow Pea Hay	186	186
February 1912	Grain Mixture	232	232
	Silage	1015	1015
	Stover	290	290
March 1912	Grain Mixture	248	217
	Silage	1085	1085
	Stover	310	310

Table IV shows the totals and results for the second year of the test, in which there were two sets of cows and two sets of rations.

TABLE IV

Lot I
Open Stable

	Ration.	Total Amount of Feed.	Value per ton	Total cost of Feed.	Average cost of Feed per head	Pounds of milk Produced.	Value of milk.	Average value of milk per head.	Cost of Grain per 100 lb. milk.	Total cost of Feed per 100 lb. milk.
October 1911	Grain Mix	1434	$24.	17.208	2.458					
	Pasturage	31d.	05	10.85	1.550					
				28.058	4.008	3639.8	76.436	10.919	.473	.770
November 1911	Grain Mix	1528	24.	18.336	2.619					
	Pasturage	14d.	.05	4.900	.700					
	Silage	4165	4.	8.330	1.190					
	Cow P. H.	882	15.	6.615	.945					
				38.181	5 454	3019.5	63.409	9.058	.607	1.264
December 1911	Grain Mix	1598.5	24.	19.182	2.740					
	Silage	7595	4.	15.190	2.170					
	Cow P. H.	1302	15.	9.765	1.395					
				44.137	6.305	3826.3	80.352	11.479	.501	1.153
January 1912	Grain Mix	1507	24.	18.084	2.583					
	Silage	7595	4.	15.190	2.170					
	Cow P. H.	1302	15.	9.765	1.395					
				43.039	6.148	4018.0	84.378	12.054	.450	1.071
February 1912	Grain Mix	1360	24.	16.320	2.331					
	Silage	7105	4.	14.210	2.030					
	Stover	2030	8.	8.120	1.160					
				38.650	5.521	3619.5	76.009	10.858	.450	1.067
March 1912	Grain Mix	1271	24.	15.252	2.178					
	Silage	6510	4.	13.020	1.860					
	Stover	2170	8.	8.680	1.240					
				36.952	5.278	3350.2	70.354	10.050	.455	1.102

LOT II
OPEN STABLE

October 1911	Grain Mix	1179.5	28.	16.513	2.752					
	Pasturage	31d.	.05	9.300	1.550					
				25.813	4.302	2824.0	59.304	9.884	.584	.914
November 1911	Grain Mix	1138	28.	15.932	2.655					
	Pasturage	14d.	.05	4.200	.700					
	Silage	3570	4.	7 140	1.190					
	Cow P. H.	756	15.	5.670	.945					
				32.942	5.490	2328.3	48.894	8.149	.684	1.414
December 1911	Grain Mix	1272	28.	17.808	2.968					
	Silage	6510	4.	13.020	2.170					
	Cow P. H.	1116	15.	8.37	1.395					
				39.198	6.533	2691.1	56.513	9.419	.662	1.456
January 1912	Grain Mix	1221	28.	17.094	2.849					
	Silage	6510	4.	13.020	2.170					
	Cow P. H.	1116	15.	8.370	1.395					
				38.484	6.414	2691.9	56.529	9.421	.635	1.429
February 1912	Grain Mix	1368	28.	19.152	2.736					
	Silage	7105	4.	14.210	2.030					
	Stover	2030	8.	8.120	1.160					
				41.482	5.926	3561.8	74.797	10.685	.537	1.164
March 1912	Grain Mix	1209	28.	16.926	2.418					
	Silage	7595	4.	15.19	2.170					
	Stover	2170	8.	8.680	1.240					
				40.796	5.828	3672.9	77.131	11.019	.460	1.110

LOT III
CLOSED STABLE

October 1911	Grain Mix	1038.5	24.	12.462	2.077					
	Pasturage	31d.	.05	9.300	1.550					
				21.762	3.627	2644.1	55.526	9.254	.471	.823
November 1911	Grain Mix	988	24.	11.856	1.976					
	Pasturage	14d.	.05	4.200	.700					
	Silage	3570	4.	7.140	1.190					
	Caw P. H.	756	15.	5.670	.945					
				28.866	4.811	2516.7	52.850	8.808	.469	1.147
December 1911	Grain Mix	1294.5	24.	15.534	2.589					
	Silage	6510	4.	13.02	2.170					
	Cow P. H.	1116	15.	8.370	1.395					
				36.924	6.154	3028.5	63.598	10.599	.512	1.219
January 1912	Grain Mix	1255.5	24.	15.066	2.511					
	Silage	6510	4.	13.020	2.170					
	Cow P. H.	1116	15.	8.370	1.395					
				36.456	6.076	2817.5	59.167	9.861	.534	1.293
February 1912	Grain Mix	1026	24.	12.312	2.052					
	Silage	6090	4.	12.180	2.030					
	Stover	1740	8.	6.960	1.160					
				31.452	5.242	2566.4	53.890	8.984	.479	1.225
March 1912	Grain Mix	937	24.	11.244	2.248					
	Silage	6510	4.	13.020	2.604					
	Stover	1860	8.	7.440	1.488					
				31.704	6.340	2470.9	51.880	10.377	.455	1.283

LOT IV
CLOSED STABLE

October 1911	Grain Mix	252	28.	3.528	1.764					
	Pasturage	31d.	.05	3.100	1.550					
				6.628	3.314	272.9	5.730	2.865	1.292	2.429
November 1911	Grain Mix	286	28.	4.004	2.002					
	Pasturage	14d.	.05	1.400	.700					
	Silage	1190	4.	2.380	1.190					
	Cow P. H.	252	15.	1.890	.945					
				9.674	4.831	694.4	14.582	7.291	.576	1.393
December 1911	Grain Mix	273	28.	3.822	1.911					
	Silage	2170	4.	4.340	2.170					
	Cow P. H.	372	15.	2.790	1.395					
				10.952	5.476	1030.3	21.636	10.818	.370	1.062
January 1912	Grain Mix	372	28.	5.208	2.604					
	Silage	2170	4.	4.340	2.170					
	Cow P. H.	372	15.	2.790	1.395					
				12.338	6.169	1269.7	26.663	13.331	.410	.971
February 1912	Grain Mix	464	28.	6.496	3.248					
	Silage	2030	4.	4.060	2.030					
	Stover	580	8.	2.320	1.160					
				12.876	6.438	1315.5	27.625	13.812	.493	.978
March 1912	Grain Mix	465	28.	6.510	3.255					
	Silage	2170	4.	4.340	2.170					
	Stover	620	8.	2.480	1.240					
				13.330	6.665	1343.7	28.217	14.108	.484	.992

Table V shows the cows in the test, the food consumed and the type of stable used in the third year of the test, ending April 30th, 1913.

TABLE V.

LOT I.
OPEN STABLE

Grain: Unicorn Dairy Ration
or
Grain Mixture: Bran 7 parts
Gluten 3 parts

Cows in the test

	Ration	132	141	144	147	150	154	156	158	160	174	175	176
Nov. 1912	Unicorn	240	104	224	240	150	162	120	224	180	180	210	240
	Pasturage	For 15 days											
	Silage	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050
	Alfalfa	150	150	150	150	150	150	150	150	150	150	150	150
Dec. 1912	Unicorn	248	78	248	200	138	138	120	217	169	186	234	248
	Silage	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085
	Alfalfa	310	310	310	310	310	310	310	310	310	310	310	310
Jan. 1913	Grain Mixture	231	171	271	169	124	124	217	169	124	186	217	217
	Silage	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085
	Clover Hay	160	160	160	160	160	160	160	160	160	160	160	160
	Alfalfa	70	70	70	70	70	70	70	70	70	70	70	70
	Oats & Vetch	80	80	80	80	80	80	80	80	80	80	80	80
Feb. 1913	Grain Mixture	196	308	196	126	112	112	196	126	84	140	....	196
	Silage	980	980	980	980	980	980	980	980	980	980	....	980
	Timothy	70	70	70	70	70	70	70	70	70	70	....	70
	Oats & Vetch	70	70	70	70	70	70	70	70	70	70	....	70
	Cut Stover	112	112	112	112	112	112	112	112	112	112	....	112
Mar. 1913	Grain Mixture	186	341	186	124	174	124	186	124	48	124	....	186
	Silage	1085	1085	1085	1085	1085	1085	1085	1085	1085	1085	....	1085
	Alfalfa	80	80	80	80	80	80	80	80	80	80	....	80
	Cut Stover	180	180	180	180	180	180	180	180	180	180	....	180
Apr. 1913	Grain Mixture	180	315	180	120	120	120	180	120	84	120	....	180
	Silage	1050	1050	1050	1050	1050	1050	1050	1050	1050	1050	....	1050
	Cut Stover	120	120	120	120	120	120	120	120	120	120	....	120
	Oats & Vetch	120	120	120	120	120	120	120	120	120	120	....	120

LOT II
CLOSED STABLE

Cows in the Test

	Ration	56	128	129	131	136	146	149	155	159	161	163	171	177	193	195	220
Nov. 1912	Unicorn	150	134	180	90	272	210	180	....	180	150	210	130	210	180	150	102
	Pasture	For 15 days															
	Silage	1050	1050	1050	1050	1050	1050	1050	....	1050	1050	1050	1050	1050	1050	1050	1050
	Alfalfa	150	150	150	150	150	150	150	....	150	150	150	150	150	150	150	150
Dec. 1912	Unicorn	80	234	155	123	297	208	50	....	138	138	208	217	217	186	138	204
	Silage	350	1085	1085	1085	1085	1085	350	....	1085	1085	1085	1085	1085	1085	1085	1085
	Alfalfa	100	310	310	310	310	310	100	....	310	310	310	310	310	310	310	310
Jan. 1913	Grain Mix.	....	231	138	310	248	217	....	138	138	64	186	217	217	167	138	186
	Silage	....	1085	1085	1085	1085	1085	....	1085	1085	560	1085	1085	1085	1085	1085	1085
	Clover Hay	....	160	160	160	160	160	....	160	160	160	160	160	160	160	160	160
	Alfalfa	....	70	70	70	70	70	....	70	70	....	70	70	70	70	70	70
	Oats&Vetch	....	80	80	80	80	80	....	80	80	....	80	80	80	80	80	80
					Cow 110												
Feb. 1913	Grain Mix.	....	196	112	200	180	152	....	112	112	84	168	196	196	140	112	196
	Silage	....	980	980	980	980	980	....	980	980	490	980	980	980	980	980	980
	Timothy	....	70	70	70	70	70	....	70	70	70	70	70	70	70	70	70
	Oats&Vetch	....	70	70	70	70	70	....	70	70	70	70	70	70	70	70	70
	Cut Stover	....	112	112	112	112	112	....	112	112	112	112	112	112	112	112	112
Mar. 1913	Grain Mix.	....	186	124	114	155	124	....	124	124	....	155	186	186	139.5	124	186
	Silage	....	1085	1085	665	1085	1085	....	1085	1085	....	1085	1085	1085	1085	1085	1085
	Alfalfa	....	80	80	20	80	80	....	80	80	....	80	80	80	80	80	80
	Cut Stover	....	180	180	136	180	180	....	180	180	....	180	180	180	180	180	180
Apr. 1913	Grain Mix.	....	180	120	....	150	120	....	120	120	....	150	180	180	135	120	180
	Silage	....	1050	1050	....	1050	1050	....	1050	1050	....	1050	1050	1050	1050	1050	1050
	Cut Stover	....	120	120	....	120	120	....	120	120	....	120	120	120	120	120	120
	Oats&Vetch	....	120	120	....	120	120	....	120	120	....	120	120	120	120	120	120

Table VI shows the totals of feed consumed, milk produced and the cost of production by the cows in the two types of stables, for the third year of the test.

TABLE VI.

Grain: Unicorn Dairy Ration
or
Grain Mixture: Bran 7 parts
Gluten 3 parts

LOT I
OPEN STABLE.

	Ration.	Total Amount of Feed.	Value per ton.	Total cost of Feed	Average cost of Feed per head.	Pounds of milk Produced.	Value of milk.	Average value of milk per head.	Cost of Grain per 100 lbs. milk.	Total cost of Feed per 100 lbs. milk.
November 1912	Unicorn	2274	30.	34 11	2.843					
	Silage	12600	4.	25.20	2.100					
	Alfalfa	1800	20.	18.00	1.500					
	Pasturage	15d.	.05	9.00	.75					
				86.31	7.193	6157.0	129.297	10.774	.554	1.402
December 1912	Unicorn	2224	30.	33.36	2.780					
	Silage	13020	4.	26.04	2.170					
	Alfalfa	3720	20.	37.20	3.100					
				96.60	8.05	6279.2	131.863	10.988	.531	1.534
January 1913	Grain Mix	2220	26.50	29.415	2.451					
	Silage	13020	4.	26.04	2.170					
	Clover H.	1920	12.	11.52	.960					
	Alfalfa	840	20.	8.400	.700					
	Oats Vetch	960	12.	5.760	.480					
				81.135	6.761	6761.9	141.999	11.749	.405	1.199
February 1913	Grain Mix	1792	26.50	23.744	2.159					
	Silage	10780	4.	21.560	1.960					
	Timothy	770	16.	6.160	.560					
	Oats Vetch	770	12.	4.620	.420					
	Stover	1232	8.	4.928	.448					
				61 012	5.546	4703.1	98.765	8.988	.504	1.297
March 1913	Grain Mix	1753	26.50	23.227	2.111					
	Silage	11935	4.	23.870	2.170					
	Alfalfa	880	20.	8.800	.800					
	Stover	1980	8.	7.920	.720					
				63.817	5.801	5092.8	106.948	9.722	.456	1.253
April 1913	Grain Mix	1719	26.50	22.776	2.070					
	Silage	11550	4.	23.100	2.100					
	Stover	1320	8.	5.280	.480					
	Oats Vetch	1320	12.	7.920	.720					
				59.076	5.370	4924.0	103.404	9.400	.463	1.199

Lot II.
Closed Stable.

November 1912	Unicorn	2528	30.	37.920	2.528					
	Silage	15750	4.	31.500	2.100					
	Alfalfa	2250	20.	22.500	1.500					
	Pasturage	15d.	.05	11.250	.750					
				103.170	6.878	6806.9	142.944	9.529	.557	1.515
December 1912	Unicorn	2593	30.	38.895	2.593					
	Silage	14805	4.	29.610	1.974					
	Alfalfa	4230	20.	42.300	2.820					
				110.805	7.378	7559.9	158.757	10.583	.514	1.465
January 1913	Grain Mix	2595	26.50	34.383	2.455					
	Silage	14665	4.	29.330	2.095					
	Clover H.	2240	12.	13.440	.960					
	Alfalfa H.	910	20.	9.100	.650					
	Oats Vetch	1040	12.	6.240	.445					
				92.493	6.605	7330.8	153.946	10.996	.469	1.261
February 1913	Grain Mix	2156	26.50	28.567	2.040					
	Silage	13230	4.	26.46	1.890					
	Timothy	980	16.	7.840	.560					
	Oats Vetch	980	12.	5.880	.420					
	Stover	1456	8.	5.824	.416					
				74.571	5.326	6173.9	129.651	9.260	.462	1.207
March 1913	Grain Mix	1927.5	26.50	25.539	1.964					
	Silage	13685	4.	27.370	2.105					
	Alfalfa	980	20.	9.800	.754					
	Stover	2296	8.	9.184	.706					
				71.893	5.529	5304.2	111.388	8.568	.481	1.355
April 1913	Grain Mix	2040	26.50	27.030	1.930					
	Silage	14700	4.	29.40	2.100					
	Stover	1680	8.	6.720	.480					
	Oats Vetch	16·0	12.	10.080	.720					
				73.230	5.230	5833.8	122.509	8.750	.463	1.255

WEIGHTS OF COWS.

OPEN STABLE
LOT 1 1911

	January			February			March		
Cow No.	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred
132	875	4	0	885	5	1	907	6	2
136	795	5	0	792	6	1	815	7	2
137	745	4	1	742	5	2	760	6	3
144	872	4	2	879	5	3	895	6	4
145	1005	6	2	1010	7	3	1035	8	4
146	980	4	1	984	5	2	1025	6	3
151	821	3	1	795	4	2	811	5	3
154	780	2	1	750	3	2	787	4	3
	Av. 859	4	1	854	5	2	879	6	3

Average gain or loss per month

January Gain 2.26% February Loss 0.58% March Gain 2.92%

Total gain or loss for the period. **Gain 4.60%**

CLOSED STABLE
LOT II 1911

	January			February			March		
Cow No.	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred
110	1120	11	0	918	1	0	947	2	0
131	1039	1	1	1035	2	2	1018	3	3
133	983	12	0	977	13	0	855	1	0
141	869	1	0	859	2	1	863	3	2
148	840	3	2	815	4	3	897	5	4
149	794	4	2	810	5	3	820	6	4
158	794	4	2	794	5	3	812	6	4
163	1023	9	0	732	10	0	808	1	0
	Av. 932	6	1	867	5	2	877	3	2

Average gain or loss per month

January Gain 0.21% February Loss 6.97% March Gain 1.15%

Total gain or loss for the period **Loss 5.61%**

Open Stable
Lot I 1911-1912

Cow No.	October			November			December			January			February			March		
	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred
56	871	6	0	873	7	0	963	8	0	940	9	0	958	10	0	945	1	0
128	942	11	0	808	12	0	864	1	0	803	2	0	848	3	1	851	4	2
132	944	2	0	985	3	0	1053	4	1	1037	5	2	1058	6	3	1100	7	4
137	812	1	0	798	2	1	840	3	2	850	4	3	859	5	4	885	6	5
144	844	2	0	870	3	0	900	4	1	887	5	2	871	6	3	903	7	4
146	931	1	0	940	2	0	985	3	1	967	4	2	1045	5	3	1090	6	4
193	636	0	0	666	1	0	712	2	0	......	3	1	750	4	2	710	5	3
Av.	854	3	0	848	4	0	902	3	1	914	5	1	912	6	2	926	5	
	Gain 10.97%			Loss 0.7%			Gain 6.36%			Loss 2.14%			Loss 2.73%			Gain 1.53%		

Total gain or loss for the period. **Gain 13.29%**

Average gain or loss per month

Lot II
Open Stable

110	1017	8	6	1088	9	7	1140	9	8	967	1	9	1020	2	0	1043	3	1
136	917	14	0	822	1	0	851	2	0	840	3	0	870	4	1	850	5	2
147	825	2	0	850	3	1	971	4	2	878	5	3	892	6	4	925	7	5
150	815	6	1	855	7	2	871	8	3	876	9	4	882	10	5	835	11	6
154	818	1	0	854	2	1	875	3	2	865	4	3	880	5	4	915	6	5
158	816	2	0	855	3	1	885	4	2	897	5	3	898	6	4	914	7	5
	868	6	1	887	4	2	932	5	3	887	4	4	907	6	3	918	7	4

Average gain or loss per month

Gain 7.55%	Gain 2.18	Gain 5.07%	Loss 4.82%	Gain 2.25%	Gain 1.21%

Total gain or loss for the period. **Gain 13.44%**

CLOSED STABLE
LOT III 1911-1912.

Cow No.	October			November			December			January			February			March		
	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred
69	890	4	0	890	5	1	905	6	2	887	7	3	870	8	4	905	9	5
129	905	9	4	930	10	5	970	11	6	1005	12	7	1005	13	8	870	1	9
141	1085	10	0	907	11	0	912	1	0	990	2	0	910	3	0	935	4	0
148	870	2	0	915	3	1	960	4	2	979	5	3	985	6	4	1025	7	5
149	812	1	0	825	2	1	855	3	2	868	4	3	890	5	4	905	6	5
163	980	7	2	990	8	3	1077	9	4	1090	10	5	1107	11	6	1137	12	7
Av.	923	6	1	909	7	2	946	5	3	969	7	4	961	8	4	962	7	5

Average gain or loss per month

October	November	December	January	February	March
Gain	Loss	Gain	Gain	Loss	Gain
8.43%	1.51%	4.07%	2.43%	0.82%	0.1%

Total gain or loss for the period. **Gain 12.%**

LOT IV.
CLOSED STABLE

155	818	9	5	846	10	6	790	11	7	754	1*	0	777	2	0	775	3	0
156	918	0	9	907	1	0	940	2	0	952	3	0	960	4	0	961	4	1
	868	5	7	876	5	3	865	7	4	853	2	0	868	3	0	868	4	1

Average gain or loss for the month.

Gain	Gain	Loss	Loss	Gain	Neither
7.63%	0.92%	1.25%	1.38%	1.75%	0.00%

Total gain or loss for the period **Gain 7.67%**

*Abortion.

Open Stable 1912-1913
Lot I

Cow No.	November			December			January			February			March			April		
	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred	Weight	Months since Calving	Months since Bred
132	1065	6	0	1144	7	0	1122	8	1	1130	9	2	1085	10	3	1087	11	4
141	1055	11	8	......	12	9	960	1	0	973	2	0	961	3	1	935	4	2
144	899	4	1	915	5	2	895	6	3	920	7	4	890	8	5	894	9	6
147	925	4	....	904	5	....	919	6	....	942	7	....	948	8	....	948	9	...
150	941	9	....	970	10	....	961	11	....	985	12	....	995	13	....	970	14	...
154	927	5	0	940	6	0	932	7	0	965	8	1	961	9	2	960	10	3
156	1015	12	0	1022	1	0	922	2	0	1046	3	0	1036	4	1	1030	5	2
158	922	2	0	937	3	1	943	4	2	961	5	3	935	6	4	948	7	5
160	970	9	6	1000	10	7	995	11	8	1042	12	9	890	13	0	886	1	0
174	695	5	1	726	6	2	725	7	3	720	8	4	736	9	5	760	10	6
176	780	4	0	780	5	1	780	6	2	800	7	3	820	8	4	800	9	5
Av.	926	7	2	933	6	2	923	6	2	953	7	3	932	8	3	928	8	4

Average gain or loss per month

Gain	Gain	Loss	Gain	Loss	Loss
4.86%	2.19%	1-5%	3.25%	2.2%	0.42%

Total gain or loss for the period. **Gain 6.18%**

Closed Stable
Lot II 1912-1913

128	860	2	0	840	3	0	913	4	0	843	5	0	890	6	1	865	7	2
129	962	9	2	955	10	3	1001	11	4	1012	12	5	940	13	6	950	14	3
136	801	1	0	774	2	0	832	3	0	800	4	1	820	5	2	790	6	7
146	881	4	....	896	5	....	920	6	....	905	7	....	962	8	....	849	9	...
159	816	8	1	793	9	2	826	10	3	855	11	4	870	12	5	870	13	6
163	982	7	0	981	8	1	1003	9	2	1002	10	3	972	11	4	985	12	5
171	742	1	0	764	2	0	810	3	0	850	4	0	866	5	1	830	6	2
177	655	2	0	675	3	0	732	4	1	726	5	2	744	6	3	751	7	4
193	766	2	0	790	3	0	832	4	1	834	5	2	860	6	3	860	7	4
195	705	7	1	721	8	2	726	9	3	740	10	4	760	11	5	762	12	6
220	670	1	0	664	2	0	717	3	0	712	4	0	715	5	0	684	6	0
Av.	803	4	0	804	5	1	846	6	1	843	7	2	854	8	3	836	9	4

Average gain or loss for the month.

Loss	Gain	Gain	Loss	Gain	Loss
0.97%	0.12%	5.22%	0.35%	1.3%	2.1%

Total gain or loss for the period. **Gain 3.22%**

The following tabulation shows the summary of the test for three years. In this the comparisons are based upon the averages obtained with the different lots of cows fed as nearly as possible upon identical rations, and with amounts based upon the amount of production of milk by each individual.

Grain Fed	Cost of Grain to produce 100 lbs of Milk		Total Cost of Feed to produce 100 lbs of Milk	
1910–11	Open Stable	Closed Stable	Open Stable	Closed Stable
Sucrene	$.549	$.5486	$1.3143	$1.2233
Per cent Gain or Loss in Weight of Cows			Gain 4.60%	Loss 5.61%
1911–12				
Rye Dist. Grains Gluten	$.4893	$.4866	$1.071	$1.165
Per cent Gain or Loss in Weight of Cows			Gain 13.29%	Gain 12.7%
Bran Gluten	.5937	.6040	$1.248	1.304
Per cent Gain or Loss in Weight of Cows			Gain 13.44%	Gain 7.67%
1912–13				
Unicorn Dairy Feed	$.4855	$.4910	$1.314	$1.343
Per cent Gain or Loss in Weight of Cows			Gain 6.18%	Gain 3.22%

A study of the foregoing tables shows that there are no very extreme differences in the cost of production of milk in either the Open or the Closed type of stable. In three of the four tests in which comparisons may be made there is a slight advantage in favor of the Open Stable. For the winter 1910-1911 there is a difference in favor of the Closed Stable. In that test, however, some of the cows were placed in the Open Stable in mid-winter, while in the other tests they had already become accustomed to the increasing severity of the weather by being divided into lots in the moderate temperatures of the early fall.

In the comparison of the percentage gain or loss in weight of the cows during the three years it is observed that the cows in the Open Stable were consistently in lead in the amount of gain made.

Summary.

1—The cost of construction and equipment is less in the Open than in the Closed Stable.

2—The cost of labor is less in the Open than in the Closed Stable.

3—The cost of production of milk, based on the amount of food consumed, is slightly less in the Open than in the Closed Stable.

4—The effects of extreme low temperatures are practically negative in reducing the flow of milk.

5—The quality of manure is better preserved in the Open Stable method of housing cows, owing to the thorough mixing of solids and liquids with the litter, and the tramping of it by the cows, than can possibly be secured in the Closed Stable method.

6—The cleanliness of the cows and the bacterial content of the milk produced is more favorable in the Open Stable than in the Closed Stable.

7—The comfort of the milker is less favorable in the Open Stable than in the Closed Stables, when the temperatures are extremely low. During the heat of summer, however, the milking room of the Open Stable is more comfortable than is the Closed Stable.

8—Fresh air and light are perfectly supplied in the Open Stable at all times, while they are never perfectly supplied at any time in the Closed Stable.

9—The separate milking room made necessary in the Open Stable method is an advantage not likely to be provided in the Closed Stable.

10—The dangers of cows slipping on the floors of the Closed Stable, when turning out or bringing in the herd is greater than in the Open Stable. In the latter the movement of the cows into and out of the milking room is the only time when they are exposed to this danger.

11—No bad results have been experienced as a result of the freedom of the cows in the Open Stable, from horning or butting one another.

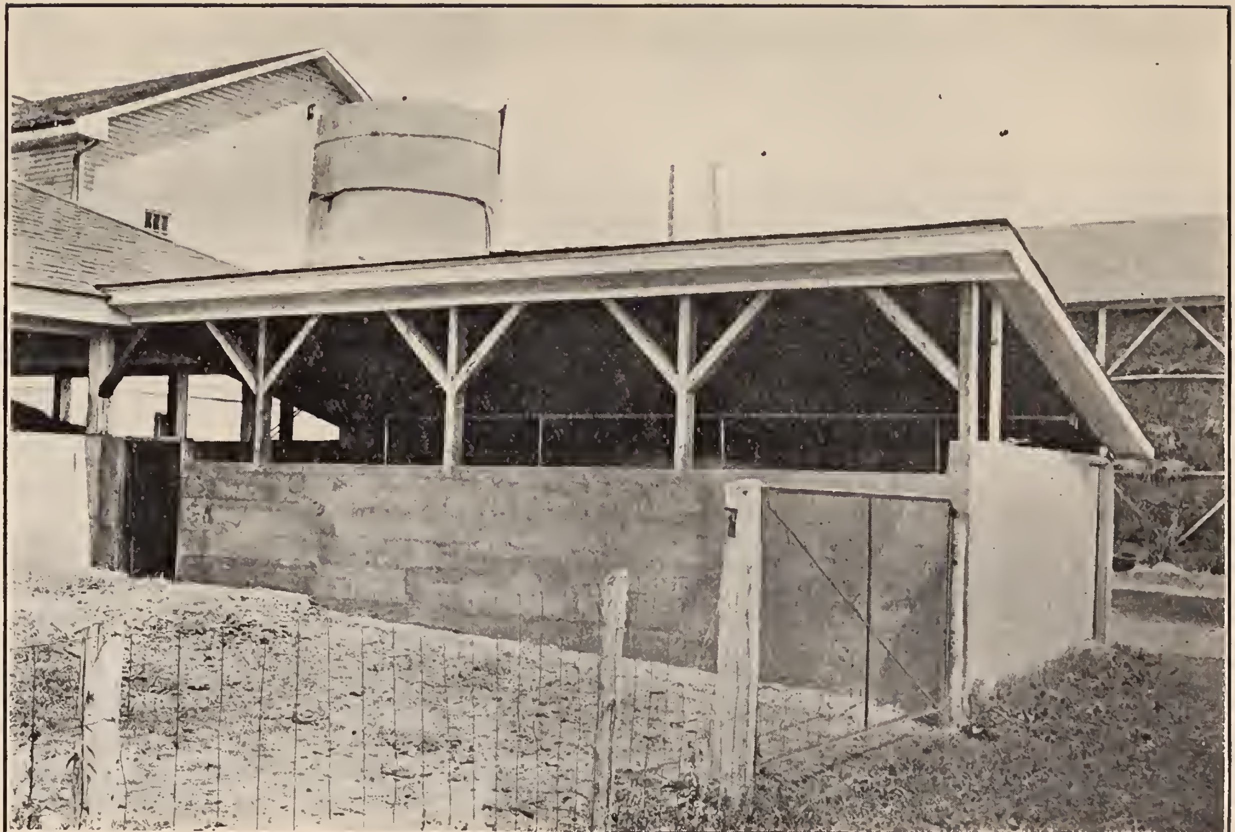
12—In all comparative tests the cows in the Open Stable made a greater percentage increase in weight for the entire period of the test than those in the Closed Stable.

A System of Stables for Cattle.

The following system of stables is recommended as providing for the maximum of efficiency in growth and production of cattle; for the preservation of normal health and vigor; and for the lessening of the dangers of, and the control of infectious diseases, when these gain admission to a herd; and for the general comfort of the cows and the convenience of handling them. This system at the same time is provided at the minimum cost of construction and maintained at the minimum cost of operation.

A herd should be divided into classes according to age and should be stabled and fed according to class.

There should be stables of the Open type for each class and yards or paddocks for each stable. The calves should be kept from contact with all other cattle and other animals. Their stable should be Open in type, and provided with ties or stanchions for convenience in feeding.



M. A. E. S. Open Calf Stable

The stables should be so constructed that they are easily and conveniently cleaned, as the calves will not thrive in the presence of filth and vermin.

A second stable should be provided for the heifers which are not yet bred, and which require a different system of feeding from that used for the calves. Some provision must be made for tying these when they are being fed grain, particularly if pure-bred, high-class animals are being produced.

A third building or compartment, separate from the others, should be provided for the heifers after they are bred and for the cows which are bred and not in milk. It is imperative that the health of these cows be determined before exposing the healthy young stock to them.

A fourth stable is then provided, with a milking room attached, for the stabling of only those cows actually in milk, such as has been described in the text of this report.

The herd bull or bulls may be provided for under the same roof but separated from the stable containing the bred reifers and cows.

The arrangement of the buildings according to position will usually depend upon the individual requirements of the dairyman or breeder, though where possible it should be arranged to have the stable convenient to the yards for each of the classes of animals, and in that way virtually maintain an efficient quarantine at all times. The matter of one or two story buildings will likewise have to be determined by the individual needs of the dairyman.

"A COMPARISON BETWEEN THE BACTERIAL CONTENT OF MILK DRAWN IN THE CLOSED STABLE, AND IN THE MILKING ROOM OF THE OPEN STABLE."

By R. W. Lamson.

It is quite a widely accepted fact that the air is the source of the greatest contamination of milk, assuming that ordinary methods of cleanliness are practiced with regard to care of cow, utensils, etc. This is especially true when open-top pails are used, as was the case in this test.

The germ content of the air in cow stables is usually higher in winter than in summer, due in a large measure to the closer confinement of the cows, and to the use of bedding, hay and dry feeds which fill the air with dust. If these sources of contamination of the air could be removed, it would be reasonable to suppose that the germ content of the air and consequently of the milk would be reduced. This condition seems to be approximated in the milking room of the open stable.

The object of this work was to determine, if possible, whether or not the open stable method of housing cattle had any advantages or disadvantages in comparison with the closed stable from the standpoint of sanitary milk production. One objection that has been raised to the open stable—and it seemed to be a point well taken, especially if a liberal supply of bedding was not used—was that the cows being free to lie down where they chose, would often lie down in manure, and therefore go to the milking rooms with the hind quarters covered with fecal matter, and unless great care was taken, involving much extra work, heavy contamination of the milk would result. The presence of fecal contamination would be indicated by the presence of Bacillus coli, and allied organisms; normal inhabitants of the intestinal tract of man and other animals.

An attempt has been made to show the comparative contamination from this source in both barns. The results will be found in table 7.

This work was started December 9, 1912, and was continued until January 31, 1913. Three cows, numbers 147, 158 and 154, were used in the open stable throughout the experiment. Owing to another experiment which I was conducting in the closed stable, the same three cows were not used each time. But those used always consisted of No. 128 and two others selected from among Nos. 136, 155, 129, 195, 161, 163 and 159. Two of the cows in the open stable, Nos. 147 and 154, were Ayrshires. No. 158 a grade Jersey. Of those used in the closed stable Nos. 136, 155, 161 and 159 were Jerseys, and Nos. 129, 163, 128, were grade Jerseys, and No. 159 a pure-bred Guernsey. The

cows in the closed stable were curried and brushed each morning. In the open stable cows were curried once or twice a week, and bedded with wheat straw each morning. In the closed stable the bedding was left under the cows during the day. Grain was fed fifteen to twenty minutes before milking in closed stable, and at the time of milking in open barn. Hay was not fed until after milking. Udders of all cows were cleaned with a damp cloth.

Open-top pails, sterilized by live steam, were used for milking into, using individual sterile pails. Milkers washed their hands before milking each cow.

Method.

All the milk was milked into the pail from one or two of the cows, and is hereafter referred to as the "ordinary method," or Method I. With the other two or one, as the case might be, the first two or three streams of fore-milk were discarded and the remaining milk only collected into the pail. This is referred to as "fore-milk discarded," or Method II.

See table I, for a partial plan of the experiment which will doubtless aid in interpreting tables II and III.

Table 1—Plan of Experiment for using methods I and II

Date	Open Stable						Closed Stable					
	Cow No.	Method	Cow No.	Method	Cow No.	Method	Cow No.	Method	Cow No.	Method	Cow No.	Method
Dec. 11	147	I	158	II	154	I	155	I	129	II	128	I
Dec. 12	"	I	"	II	"	I	"	I	"	II	"	I
Dec. 13	"	I	"	I	"	II	195	I	161	II	"	I
Dec. 14	"	I	"	I	"	II	"	I	"	II	"	I
Dec. 16	"	II	"	II	"	I	136	II	"	I	"	II
Dec. 17	"	II	"	II	"	I	"	II	"	I	"	II
Dec. 18	"	I	"	II	"	II	159	I	"	II	"	II
Dec. 19	"	I	"	II	"	II	"	I	"	II	"	II
Dec. 20	"	II	"	I	"	II	"	II	155	I	"	II
Dec. 21	"	II	"	I	"	II	"	II	"	I	"	II
Dec. 23	"	II	"		"		161	I	"	II	"	I

Bacteriological Technique.

10 c. c. samples were taken from entire yield of each cow, with a sterile 10 c. c. Mohr's pipette, and placed in sterile 50 c. c. salt-mouth bottles. Within thirty to forty minutes the samples were plated out according to the following method. The bottle containing the sample was vigorously shaken twenty-five times, to insure fairly uniform distribution of the organisms. 1 c. c. of the milk was introduced into 99 c. c. of sterile water in a 250 c. c. glass-stoppered bottle. This bottle and contents was also shaken twenty-five times and 1 c. c. and .1 c. c. portions introduced into sterile petri dishes 100 m. m. wide by 10 m. m.

deep, making dilutions of 1-100 and 1-1000 respetively. Sometimes it was necessary to make dilutions of 1-10,000, but the lower dilutions were used whenever possible because of greater accuracy in results. About 8 c. c. of agar-agar added, and the plates gently rotated to distribute the organisms. Duplicate plates were made in every case, and result in tables represent averages of at least two plates.

The agar-agar was made according to the following formula:

Agar-agar	15 grams.
Witte's peptone	5 grams
Liebig's beef extract	5 grams.
Water (dist.) to make volume of	1000 c. c.

Medium neutralized with NaOH and final reaction brought + 1.2 per cent. to 1.5 per cent. acid to normal HCl, using phenolphythalein as an indicator.

As soon as the plates were cooled they were inverted and incubated for four days in a Hearson's low temperature incubator at a temperature of 22 degrees C. to 23 degrees C. At the end of that period they were counted, using a Wolffhuegel's counting apparatus equipped with Jeffer's counting plate. The counting was done under an ordinary reading glass of four inch diameter. See tables 2 and 3 for counts.

At the same time that a 1 c. c. portion of sample was taken for dilution another 1 c. c. portion of the milk was introduced into a Smith's fermentation tube containing lactose-bile fermentation medium. These fermentation tubes were incubated four days at 37.5 degrees C. At the end of which time the percentage of gas formed was recorded, and a fermentation of 25 per cent. or more taken as an indication of the presence of Bacillus coli, or allied organisms, thus showing contamination from fecal matter. See table 7 for results.

These samples were taken as previously stated from December 9, 1912, to January 31, 1913, and were all from the evening milking. During that time we had several extremes of weather, probably accounting for the high results for some days, the temperature in both barns ranging from 28 degrees F. to 60 degrees F. at time of milking. During the milking usually of the second cow, a sterile plate of agar-agar 100 m. m. in diameter was exposed back of the cows in each barn for 60 seconds, and the plates incubated and counted with the others made that day. See table 6 for results of these counts.

Table 2—Bacterica per C. C. from cows in open stable

Cow No.	Method	Count-number in 1 c. c.	Cow No.	Method	Count-number in 1 c. c.	Cow No.	Method	Count-number in 1 c. c.
147	I	4200	158	I	2000	154	I	3000
"	"	2400	"	"	5100	"	"	9600
"	"	3900	"	"	4700	"	"	2900
"	"	1400	"	"	9450	"	"	1100
"	"	2800	"	"	5700	"	"	2500
"	"	4500	"	"	10750	"	"	23500
"	"	15750	"	"	6500	"	"	15100
"	"	3000	"	"	4100	"	"	17500
"	"	4500	"	"	8300	"	"	13500
"	"	31100	"	"	35800	"	"	58400
"	"	3700	"	"	6700	"	"	13650
"	"	3700	"	"	10100	"	"	3500
"	"	12700	"	"	9400	"	"	4000
"	"	5800	"	"	8000	"	"	9100
"	"	5700	"	"	17200	"	"	21475
"	"	6200	"	"	17900	"	"	10300
"	"	10800	"	"	11800	"	"	30000
"	"	14000	"	"	23600	"	"	49500
"	"	13300	"	"	12800	"	"	32000
"	"	5300	"	"	22000	"	"	57800
"	"	6500				"	"	61000
						"	"	61500
Total		= 161250	Total		= 231900	Total		= 500925
Average =		161250 ÷ 21 = 7678	Average =		231900 ÷ 20 = 11595	Average =		500925 ÷ 22 = 22769
147	II	2900	158	II	6000	154	II	3800
"	"	1100	"	"	4600	"	"	1400
"	"	2700	"	"	5700	"	"	6600
"	"	7300	"	"	6150	"	"	10200
"	"	4300	"	"	2650	"	"	15100
"	"	4100	"	"	9400	"	"	15900
"	"	4650	"	"	9700	"	"	5000
"	"	6900	"	"	12800	"	"	16200
"	"	34400	"	"	21700	"	"	31300
"	"	3550	"	"	14150	"	"	5400
"	"	5600	"	"	5100	"	"	15900
"	"	11400	"	"	12600	"	"	4400
"	"	1850	"	"	9400	"	"	20400
"	"	2000	"	"	11800	"	"	20100
"	"	2250	"	"	6000	"	"	42500
"	"	3150	"	"	11500	"	"	46700
"	"	2650	"	"	11600	"	"	41250
"	"	12600	"	"	16300	"	"	47000
"	"	9200	"	"	17800	"	"	60000
"	"	13800	"	"	19500	"	"	14500
"	"	15100	"	"	8000	"	"	31000
"	"	9000	"	"	11400			
Total		= 160500	Total		= 233850	Total		= 454650
Average =		160500 ÷ 22 = 7295	Average =		233850 ÷ 22 = 10630	Average =		454650 ÷ 21 = 21650

Table 3—Bacteria per C. C. from cows in closed stable.

Cow No.	Method	Connt-number 1 c. c.
136	I	3350
"	"	1450
"	"	1900
"	"	4250
"	"	3750
"	"	3250
Total		17950
Average 17950 : 6 = 2990		
129	I	14500
"	"	5300
"	"	21600
"	"	16950
Total		58350
Average 58350 : 4 = 14587		
163	I	8100
"	"	5400
"	"	7300
"	"	16800
Total		37600
Average 37600 ÷ 4 = 9400		

Cow No.	Method	Count-number 1 c. c.
155	I	5800
"	"	5200
"	"	1600
"	"	3800
"	"	8000
"	"	4800
"	"	3300
"	"	5350
Total		37850
Average 37850 : 8 = 4731		
195	I	9800
"	"	1400
"	"	14400
"	"	7000
"	"	3700
"	"	6500
"	"	16200
"	"	2400
"	"	5000
Total		60400
Average 60400 : 9 = 7611		
161	I	23100
"	"	3000
"	"	800
"	"	900
"	"	2600
Total		30400
Average 30400 : 5 = 6080		

Cow No.	Method	Count-number 1 c. c.
128	I	11400
"	"	4300
"	"	24000
"	"	1800
"	"	3600
"	"	3600
"	"	2100
"	"	3600
"	"	1900
"	"	9100
"	"	3000
"	"	6500
"	"	3200
"	"	1300
"	"	5200
"	"	9200
"	"	8600
"	"	1100
"	"	3600
Total		107100
Average 107100 : 19 = 5637		
159	I	5500
"	"	4300
"	"	1500
"	"	3600
"	"	2250
"	"	4500
"	"	44900
Total		66550
Average 66550 : 7 = 9507		

Table 3 continued

Cow No.	Method	Count-number 1 c. c.
136	II	1600
“	“	2000
“	“	2000
“	“	4400
“	“	6400
“	“	1300
“	“	5900
“	“	3900
Total		27500
Average 27500 ÷ 8 = 3437		
129	II	8500
“	“	8800
“	“	3450
“	“	8500
“	“	7500
“	“	14100
“	“	24500
Total		75350
Average 75350 ÷ 7 = 10764		
195	II	12450
“	“	3250
Total		15700
Average 15700 ÷ 2 = 7850		

Cow No.	Method	Count-number 1 c. c.
155	II	3400
“	“	2550
“	“	1500
“	“	6250
“	“	8800
“	“	10600
“	“	5500
Total		38600
Average 38600 ÷ 7 = 5514		
161	II	4300
“	“	1000
“	“	2000
“	“	2600
“	“	4500
“	“	1700
“	“	1000
“	“	3300
“	“	1600
Total		22000
Average 22000 ÷ 9 = 2444		
163	II	4200
“	“	4200
“	“	10150
Total		21100
Average 21100 ÷ 4 = 5275		

Cow No.	Method	Count-number 1 c. c.
128	II	900
“	“	2700
“	“	3800
“	“	4500
“	“	2000
“	“	4350
“	“	1800
“	“	1050
“	“	1100
“	“	1550
“	“	4800
“	“	9650
“	“	1100
“	“	6500
“	“	1250
“	“	11100
“	“	5550
“	“	1350
“	“	800
“	“	2300
“	“	6400
“	“	1200
“	“	6000
Total		81750
Average 81750 ÷ 23 = 3554		
159	II	800
“	“	5050
“	“	3350
“	“	2650
“	“	2050
“	“	10550
Total		24450
Average 24450 ÷ 6 = 4075		

I. Ordinary method all milked into pail.
II. Fore milk discarded not milked into pail.

It would seem on a superficial examination of the counts and averages of milk produced in the open as compared with the closed stable, that there is quite a distinct advantage in favor of the closed stable as shown by the lower count in the milk drawn in the latter place. But with the aid of table 4, I think I can explain this seeming discrepancy in results. The individuals, both cow and milker, are very important factors in a comparison of this kind, and it is unfortunate that it was not possible to use the same three cows for the work in each barn, housing them for a time in one stable and then changing to the other, also keeping the same milker throughout. From other work that I have done I am able to check the milkers quite closely, and find that their methods of milking are so similar as to make very little variation in germ content of milk, whether milked by one or the other, and they will be disregarded in this comparison.

The number of bacteria in fresh milk drawn under aseptic conditions has been a subject of much controversy. The idea that the milk within the healthy udder is germ free probably originated with Lister[1] from an examination of a few samples.

At the other extreme is the finding by Hastings and Hoffmann[2] of an apparently healthy cow with an average udder content of 191,000 germs per c. c. of milk.

Harding and Wilson[3] report examination of the udder flora of 1,230 samples, representing 78 cows, the average germ content being 428 per c. c. This is a very low average for such a large number of analyses; and compared with previous work it shows that a very wide variation is possible in the germ content of the udder of individual cows, and this variation must be taken into account when comparing such averages as are found in tables 2 and 3.

Examination was made of the milk from each cow usually every other day, to determine the udder content.

The technique used is as follows: The cows were about half milked from all teats, then the udder and teats of the cow, and the milker's hands were thoroughly cleaned with 95 per cent. alcohol. One stream of milk from each teat was then drawn into a sterile 250 c. c. Erlenmeyer flask, the entire operation requiring about thirty seconds. The samples were taken to the laboratory and plated within a half hour. The content of the Erlenmeyer flask was shaken 25 times, and if necessary a 1 c. c. portion transferred to 99 c. c. of sterile water, but usually it was possible to plate with the milk direct, using .1 c. c., .5 c. c. or 1 c. c. The remainder of the method is as previously described. See table 4 for results.

---

(1) Lister J. Lactic fermentation and its bearing on pathology. (Pharm. Jour. and Trans.) (Pathological societies of London) III. Series, 8: 555-558, 572-575. 1878.

(2) Hastings, E. G., and Hoffmann, C. Bacterial content of the milk of individual animals. Wis. Agr. Expt. Sta. Research bulletin No. 6, 1909, also Ann. Reports 25 and 26. (1908-1909) pp. 189-196. 1910.

(3) Harding, H. A. and Wilson. J. K. Tech. bulletin No. 27, N. Y. Agr. Expt. Stat., Geneva, N. Y.

Table 4—Total count on germ content of the udder

Cow No.	Count-No. in 1 c. c.	Cow No.	Count-No. in 1 c. c.	Cow No.	Count-No. in 1 c. c.	Cow No.	Count-No. in 1 c. c.
136	900	155	650	129	1050	195	3200
"	300	"	750	"	2250	"	350
"	2400	"	1700	"	4300	"	850
"	190	"	415	"	3250	"	1050
"	80	"	70	"	350	"	400
"	1230	"	510	"	9500	"	1200
"	635	"	930	"	9900	"	550
"	....	"	700	"	10100	"	3700
"	1350	"	*(4000)	"	4800	"	700
"	....	"	....	"	....	"	1000
"	1100	"	1250	"	....	"	550
Total	8185	Total	7975	Total	45500	Total	13550
Average 8185 ÷ 9 = 910		Average 7975 ÷ 9 = 885		Average 45500 ÷ 9 = 5055		Average 13550 ÷ 11 = 1322	
161	1400	159	300	128	500		
"	300	"	350	"	250		
"	250	"	...	"	800		
"	....	"	...	"	450	163	5550
"	....	"	350	"	395	"	10950
		"	375	"	605	"	6600
		"	165	"	610	"	1300
		"	130	"	90	"	600
		"	285	"	25	"	4200
		"	700	"	120	"	
"	400	"	500	"	120	"	7400
"	....	"	705	"	190	"	2250
"	1200	"	350	"	400	"	
Total	3550	Total	4210	Total	6265	Total	38850
Average 3550 ÷ 5 = 710		Average 4210 ÷ 11 = 382		Average 6265 ÷ 13 = 482		Average 38850 ÷ 8 = 4856	
147	750	158	2150	154	4050		
"	850	"	1900	"	1600		
"	1650	"	2950	"	10200		
"	1450	"	5500	"	1200		
"	1450	"	5750	"	1500		
"	450	"	3300	"	1300		
"	1850	"	750	"	1500		
"	2250	"	2800	"	4600		
"	700	"	3500	"	2200		
"	1000	"	4050	"	5500		
"	2700	"	2400				
"	1600	"	2700	"	600		
"	550	"	3000	"	200		
Total	17250	Total	40750	Total	34450		
Average 17250 ÷ 13 = 1327		Average 40750 ÷ 13 = 3134		Average 34450 ÷ 13 = 2650			

*The count of 4000 under cow No. 155 was purposly omitted from the averages.

By taking the averages in round numbers of the total count by methods I and II, tables 2, 3 and 4, and of the germ content of the udder, and dividing the total count by the average germ content of the udder, the per cent. increase of bacteria in the pail over the number found in the udder is determined, and the relative value of the two stables for sanitary milk production, is thereby set forth.

Table 5—Percent increase in number of bacteria found in the udder of the cow and in the pail

Cow No.	Method	Total		Count on Udder		Percent Increase
136	I	3000	÷	900	=	333%
"	II	3400	÷	900	=	377%
155	I	4700	÷	900	=	522%
"	II	5500	÷	900	=	611%
129	I	12700	÷	5100	=	249%
"	II	10800	÷	5100	=	211%
195	I	6900	÷	1300	=	530%
"	II	7900	÷	1300	=	607%
161	I	7000	÷	700	=	1000%
"	II	2700	÷	700	=	385%
159	I	9500	÷	400	=	2375%
"	II	4000	÷	400	=	1000%
128	I	5600	÷	500	=	1120%
"	II	3600	÷	500	=	720%
147	I	8500	÷	1300	=	653%
"	II	7300	÷	1300	=	561%
158	I	11600	÷	3200	=	362%
"	II	10600	÷	3200	=	331%
154	I	22800	÷	2700	=	844%
"	II	21200	÷	2700	=	785%

Cow No. 163 was omitted from the averages because of the small number of times she was used for methods I and II

Total averages—Open Stable

Cows 147, 158, 154, —Method 1—1839% ÷ 3 = 618% Average increase
Cows " " " —Method 2—1677% ÷ 3 = 559% Average increase

Total averages—Closed Stable

Cows 136, 155, 129, 195, 159, 161, and 128—Method 1 = 6129 ÷ 7=875% Average % increase.
Cows " " " " " " and " —Method 2=3911 ÷ 7 = 558% Average % increase.

From the averages of all of the cows used in the open and closed stables by methods I and II an increase of 257 per cent. is noted in the closed stable by method I, thus showing a decided advantage in favor of the open stable. By method II both stables agree very closely.

Table 6—Counts on plates exposed to air for 60 seconds

Date		Closed Stable	Open Stable	Date		Closed Stable	Open Stable
December	11	55	50	January	8	32	72
"	12	240		"	9	118	40
"	13	138	63	"	10	164	
"	14	93	32	"	11	43	58
"	16	69	64	"	13	82	155
"	17	83		"	14	193	89
"	18	72	108	"	15	132	73
"	19	75	53	"	16	102	
"	20	48		"	17	48	71
"	21	184	37	"	18	95	82
"	23	70	48	"	20		84
"	24	32	25	"	21	140	78
"	26	43	50	"	22	314	150
"	27	70	42	"	23	147	97
"	28	80	46	"	24		
"	30	57	44	"	25	100	96
"	31	71	61	"	27		60
Jannary	2	72	138	"	28	305	
"	3	76	190	"	29	216	105
"	4	178	58	"	30	165	40
"	6	72	60	"	31	55	116
"	7	30	54				

Total open Stable – 2689
Average = 2689 ÷ 36 = 75

Total closed Stable – 4369
Average = 4369 ÷ 40 = 105

The figures opposite each other in columns 1 and 2, 3 and 4, are the counts for the same day in the rspective stables. It will be noted that the counts in the open stable are quite constant; only seven times does the count exceed 100, while in the closed stable it is 100, or over sixteen days out of forty. Blank spaces indicate colonies so spread that counting was impossible. Twenty-four out of thirty-six times the count in the open stable was less than the corresponding count in the closed stable. The average counts of the two stables show about 25 less in the open stable.

Table 7—Per cent Fermentation in lactose-bile medium

CLOSED STABLE								OPEN STABLE		
Cow No. 136	Cow No. 155	Cow No. 128	Cow No. 129	Cow No. 195	Cow No. 161	Cow No. 159	Cow No. 163	Cow No. 147	Cow No. 158	Cow No. 154
—	100%	10%						20%	—	—
	12%	—	25%					5%	20%	15%
	—	—	—					21%	—	—
		22%		—	22%			—	—	20%
		—		—	—			—	—	20%
—		10%			—			20%	—	20%
		45%			35%	—		10%	20%	20%
		—			—	—		—	—	30%
	—	100%				—		—	—	10%
	—	—				—		—	50%	—
	—	—			60%			15%	5%	15%
	—	—			—			—	—	15%
5%		—	—					—	5%	21%
10%		30%						—	—	—
—		—		20%				35%	—	60%
	—	—				—		—	—	45%
—		—		5%				15%	—	20%
—		—		35%				22%	22%	30%
		—	—				30%	—	—	—
		—	—			—		—	100%	45%
		—				25%	5%	30%	—	30%
		5%				35%	5%	—	5%	30%
10%	—	—						—	—	20%
—	—	30%						20%	—	15%
		—	—			35%		—	—	—
		5%	—			30%		5%	22%	5%
		—		—			—	—	20%	20%
	—	—				—		25%	—	—
	—	—					—	—	40%	20%
—		*	40%					20%	—	—
		—		—	—			5%	—	40%
		—		—	—			—	—	30%

Total percent for closed stable 620% using 25% or more. Average 620% ÷ 14 = 44 + % fermentation

Total percent for open stable, 590% using 25% or more. Average 590 ÷ 14 = 42% fermentation.

The spaces in the above table that are entirely blank, indicate that the cow was not used on that day. A dash indicates 0 per cent. fermentation. The average per cent. of fermentation of the two stables, while not differing enough to give either any decided advantage, does show that the Bacillus coli is not any more prevalent in milk as produced in the open than in that produced in the closed stable. It is interesting to note the constancy with which the milk from cow No. 154 showed a fermentation. Comparing her with cow No. 136 of the closed stable, it would seem to indicate that one cow is naturally cleaner than another; thus it is evident that the individual animal is

an important consideration in producing milk of low bacterial content. No attempt has been made as yet to find out the real cause for this difference, but I hope to be able to do this for a future publication.

Conclusions.

1. It does not seem best to draw any but general conclusions at this time, owing to the limited data at hand, and the many varying conditions. But it seems safe to conclude, from results in tables 2, 3 and 4, that there is quite an advantage in favor of the open stable as a place to produce milk of a low germ content.

2. Table 6 shows quite positively that the germ content of the air in the milking room of the open stable is less than in the closed stable. This factor alone is important in producing sanitary milk.

3. From table 7 it would seem safe to conclude that fecal contamination of milk in the open stable, as indicated by a fermentation of 25 per cent. or more in lactose-bile medium, is not any greater than in the closed stable, where the cows require more careful attention.

INDEX.

Page.

A.

B.

C.

D.

Page.

Page.

G.

H.

I.

Page.

N.

O.

P.

R.

Page.

S.

Page.

T.

U.

V.

W.

Y.